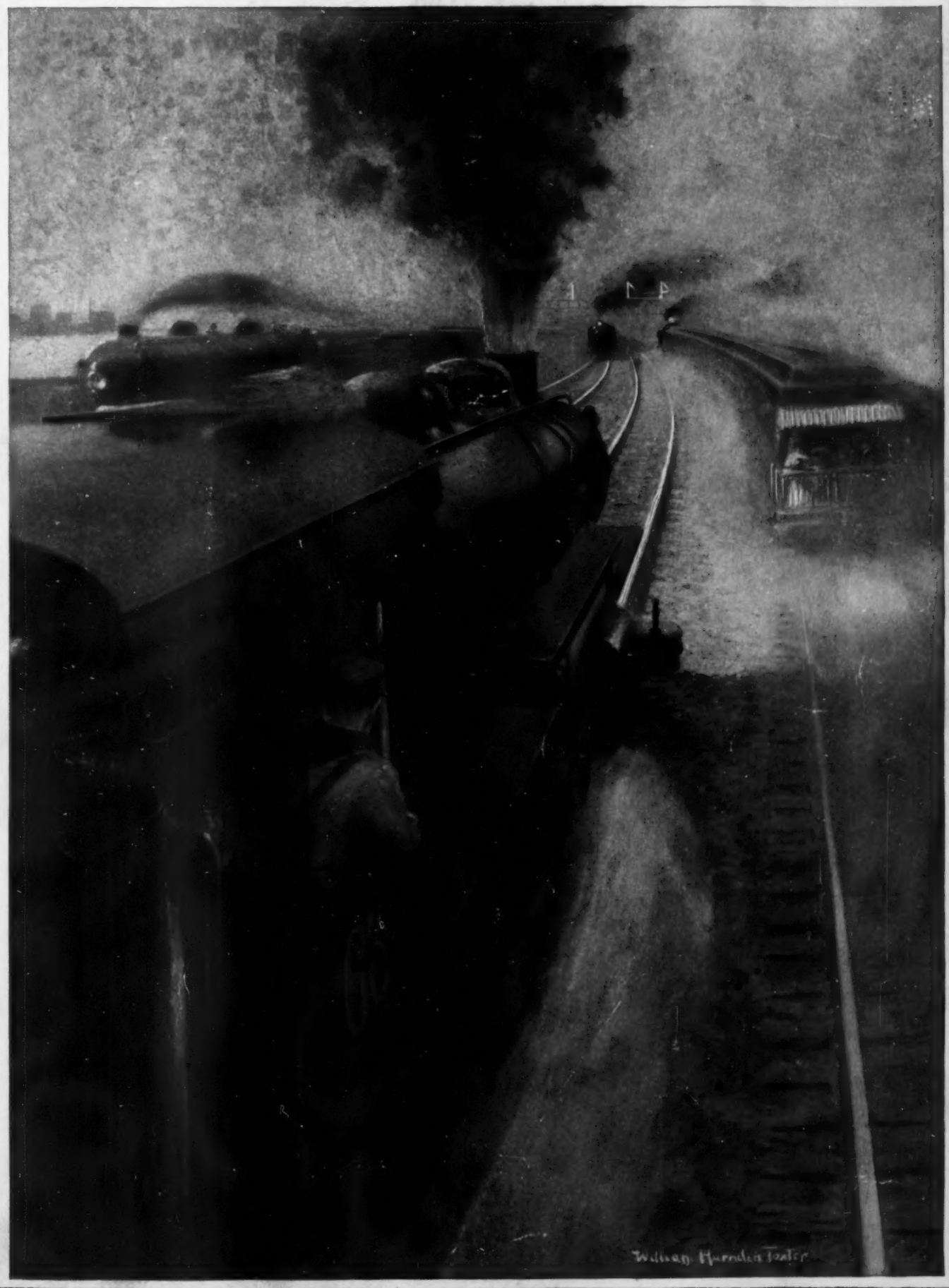
SCIENTIFIC AMERICAN



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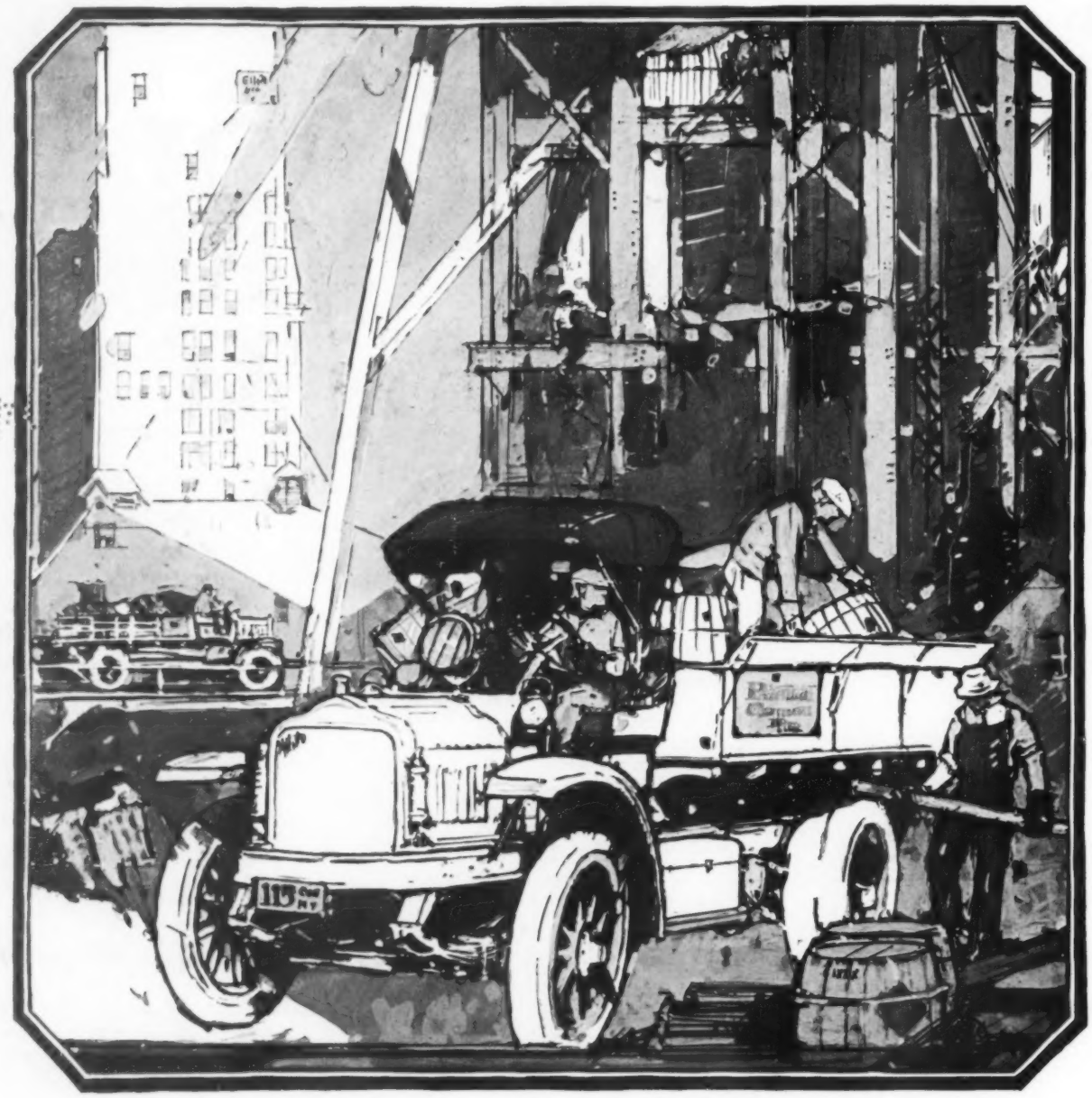

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SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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Porpoises hauled ashore, entangled in the net

Carolina fishermen hauling a big fellow out of the surf

The Playful Porpoise and Its Economic Value

By Robert G. Skerrett

IN this hastening age of ours when even seconds count in business life, it may sound paradoxical to say that we owe our punctuality and time-saving to the playful porpoise. And yet such, indeed, is the fact, for watches, clocks and the still more dignified chronometer would not run month in and month out with regularity, but for the lubricant obtained from his jaws. This oil has the unique property of being able to retain its fluidity summer and winter, and there is an authentic record of the lubricant doing its work at a temperature of quite 100 deg. below the freezing point.

A variety of other oils have been tried for the same service, but all of them have proved far less reliable. In a watch or chronometer the oil must stay where put —it must not "creep" over the mechanism and thus steal away from its proper post of duty. Therefore, it ought not to run away in the presence of considerable heat. Neither should the oil oxidize, evaporate, or grow rancid. These exacting requirements are met in their entirety only by porpoise-jaw oil, and it is no wonder that the stuff when refined sells wholesale in the neighborhood of $25 a gallon. There are many other mechanisms that are best cared for by using propoise-jaw oil, such, for instance, as talking machines, delicate recording apparatus, etc.

There was a time when the occasional fisherman and some of the Indians along the New England coast captured enough porpoises from season to season to cover the demand for this oil, but with the introduction of cheaper watches and the more general possession of the pocket timepiece this irregular source of supply failed to suffice. It was then that Mr. William F. Nye, of the famous old Whaling City, New Bedford, set about organizing the porpoise-catching business upon thoroughly efficient lines. Experience had proved that the character of the oil depended much upon the freshness of the fat at the time the oil was rendered and also upon the healthy state of the porpoise itself.

Stripping and loading the blubber and skins

Preparing to "cut in"

The porpoise on our Atlantic coast is fattest from November to April, and therefore makes the most profitable catch during that period. Instead of harpooning them, as had been the custom, Mr. Nye introduced the use of extremely heavy seines, and it is in this way that the porpoises are now taken. The principal fishing grounds are along the Carolina coasts, and the biggest station is located near treacherous Cape Hatteras. As soon as a school of these miniature members of the whale family are seen by the ever-watchful lookouts at the "spy camps," the fishermen launch their dories through the surf and cast the nets at right angles to the shoreline and directly across the path of the oncoming porpoises.

The moment the seines feel the weight of the struggling creatures, the fishermen tug the outer end of the net beachward, and, not infrequently, a horse has to be called into service to get the catch rounded up and landed. The frightened porpoise, weighing often more than 300 pounds apiece, is a dangerous antagonist, because a blow from its tail may break the bones of a fisherman who has waded into the surf to hook it for the purpose of getting it more quickly ashore. The haul may range from a score of porpoises to five times that number, and inasmuch as the seining can be done but a few hundred yards at most from the shore the fishermen are very much handicapped by the surf.

The oil is obtained from the lower jaw bone and jowls, where the fat is of a white, spongy texture. The yield varies from one quart to three quarts of crude oil per porpoise, depending upon the size. But this shrinks a good deal during the refining operations. The fat is rendered immediately at the camps, so as to insure freshness, but the subsequent treatments are carried out as a rule at New Bedford. For eight months the crude oil is left to settle and to clarify itself in the presence of sunshine. When the winter weather is too mild at New Bedford the oil is sometimes sent even to Canada in order to obtain the natural cold needful for some of the stages of self purification.

In order to get rid of animal matter and other imperfections, the oil is strained through blankets to remove the so-called "gum"; and an interval of something like two years elapses from the time of the first trying-out at the fishing stations before the finished lubricant is fit for use. Because of its peculiar properties as a lubricant only a very little of the oil is needed upon working parts. It is said that porpoise-jaw oil will stand for three years on the pivots of a watch without change.

The body oil from the porpoise is also a valuable lubricant, but it is in no way to be compared with the oil from the jaw, and, therefore, does not fetch anything like the same price. The skin of the porpoise is likewise of commercial value, yielding a fine-grained leather which is made into a variety of high-grade articles.

Cost of Brick Roads in the Country

THE great cost of repairs to macadam roads is rapidly persuading farmers that brick or cement roads are cheaper in the long run because of their splendid wearing qualities.

The following formula is a rough guide for the probable expense of a brick road when built with a 6-inch concrete foundation and suitable grades:

Cost per square yard, 1.90 L + 0.213 C + 0.138 S + 0.157 A + 0.040 B.

In this formula C equals cost of cement per barrel, S the cost of sand per cubic yard, A equals cost of aggregate per cubic yard, B equals cost of paving bricks per thousand, and L equals cost of labor per hour. Thus if labor costs 25 cents per hour, the labor cost per square yard of pavement will be 1.90 times 25 cents or 48.25 cents. The cost of the cement per square yard will be 0.213 times the price of a barrel, and so on with the other items.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The Mexican Situation

THE delivery of the American note to the head of the de facto government of Mexico, and the simultaneous call of the organized militia into the service is significant of two things. First, that the long period of watchful waiting has ended; second, that we have been brought to the realization that only by a show of ample force can diplomatic correspondence be depended upon to produce results.

The situation is serious, but there is nothing in it to produce hysteria; there is absolutely no threat of national disaster, even if it comes to open war. A consideration of the resources of the two nations should convince the most pessimistic that there can be no doubt of the outcome. The reports of the addresses of General Carranza to the people of Mexico City indicate that he appreciates that his country cannot hope to make a successful resistance if attacked.

His own obstinacy, or political considerations of which we have no definite knowledge, have forced the Mexican leader into a position from which retirement seems impossible to a man of his proven characteristics. He has made a demand, coupled with a threat; his demand has been definitely refused and his threat met with a plain statement that if it be carried out it will be met as it deserves. In the meantime his words and his orders to his subordinates have fanned the flames of Mexican hatred and distrust toward the United States to a white heat. Even if he were inclined to temporize further, there is every reason to believe that he can control his countrymen only along one course, and that is toward war.

The American note was an admirable and fair statement of fact. It places on record the events of the past three years. No impartial reader could retain any doubt of the sincere friendship of the American people and their leaders toward our neighbors to the south, nor of our desire that they alone should bring about a settlement of their internal difficulties. We challenge history to show a case where a strong nation has submitted to even half the insult, outrage and injury and yet withheld its hand. For much less we ourselves have threatened the breach of relations with a powerful nation, in spite of the political strength of its former nationals, now citizens of this country.

The note should have a good effect in allaying the excitement and resentment of Central and South American republics, which are reported in press dispatches to be in sympathy with Mexico in the present crisis. And doubtless our future course will strengthen the impression. If war comes, it will be Mexico's act, and not ours; this should be and must be made plain to all.

To-day, in spite of the mobilization of our militia, all our arrangements are made for the maintenance of peace. Our army and the militia of Texas and Arizona (New Mexico's militia is not yet mobilized under the call of May 9th) are scattered in sixty-six detachments along the border, not including the force with General Pershing. The total strength of these sixty-six detachments is something under 25,000; the strength of the detachments varies from 51 to 4,468. There are 11,635 men with Pershing.

If we had in mind an invasion of Mexico, should we scatter our few available troops? Any successful military operation demands concentration of effort. Pershing's expedition, as we called attention to in our issue of April 29th, has entered Mexico in the last section which we would invade if we had any ulterior motives. The largest force, other than Pershing's, is concentrated at Douglas, Arizona, the terminus of a railroad running a short distance into Sonora; if we had in mind the invasion of Sonora we should concentrate at Nogales, on the railroad leading to the capital of that state, and to Guaymas, its only important seaport.

At Samfordyce, the nearest point to Monterey, we have only 225 men; at Laredo, the next best point for an invasion, there are 1,506 soldiers, and at Eagle Pass 2,011. These are the only favorable points of entry to the important strategic center of Northern Mexico—the Monterey-Torreon line.

And our expressed intention as to the militia is not to assemble it in camps of instruction, available to move at any point as an expeditionary force, but to send it little by little to the border to reinforce the scattered troops. We have not withdrawn Pershing's force, though he has had with him the flower of our regular cavalry—troops that would surely be needed to head any army of invasion. And none of us, Americans or Mexicans, can be so ignorant as not to know that, if intervention were intended, Mexico City and not Chihuahua would be our objective.

On the other hand, Mexico's every move during the past month has been in preparation for war. Every effort has been made to recruit her forces. Reports have it that there are now forty thousand in the State of Chihuahua, half of whom inclose Pershing's force and threaten his line of communications. From five to ten thousand are estimated as concentrating south of Laredo. In the Matamoras district are reported an equal number. The smaller garrisons have been withdrawn from their border posts to central points, and there are constant rumors of troops moving from Central Mexico northward.

Probably these numbers are exaggerated. Certainly, in personnel and equipment their forces are inferior. But there are among them some well equipped and experienced fighting units, and should a break come the initial advantage would be with the force concentrated for offensive operations, for it is certain that they would not strike us where we are prepared. Until our troops are gathered together into tactical organizations, our transport system and bases of supply established, we can hope to accomplish nothing, and, if attacked, must expect set-backs humiliating to ourselves and encouraging to our attackers.

This situation would be of short duration—it is one we would know better how to meet than the anomalous one now existing, when all the hostilities are from one side and we, on the defensive, await the next blow, unable to foretell within a thousand miles where it may fall. In a few weeks necessary forces would be mobilized and in a comparatively short time Mexico would be crushed. An unprofitable guerrila warfare, of infinite extension, expensive to us, wasteful of life and property to them, would follow; its end would be when their masses had been educated sufficiently to govern themselves somewhat in accordance with the principles of modern civilization.

We have reason to be thankful for the crisis which has resulted in the mobilization of our militia. The citizen soldiers and the regulars both will gain valuable experience. The military strength of the nation as a whole will be materially augmented from the date of the proper organization of these troops into brigades and divisions. It is well worth the price paid, even if they are never called upon to fire a shot.

We must not be misled, however, into feeling that the assembling of our citizen soldiers under arms places us among the nations prepared. And we must avoid the mistakes of our past history if war with Mexico follow and we march to comparatively easy victory. We must not feel that anything has been proved thereby, nor deceive ourselves with the vain belief that we can use the same class of troops, follow the same time-consuming methods of mobilization, depend upon the same inadequate supplies and reserves of ammunition and hope for success against a military nation. The father who, with sorrowing heart, takes up the switch to chastise his six-year-old son, does not feel himself qualified, because he carries the operation through successfully, to enter the lists as a candidate for the heavyweight championship.

If we are dragged into this distasteful task, let us do it as quickly, as justly and as mercifully as possible. It will be nothing to brag over, nothing to take pride in, and the only profit we may look for is the possibility that future generations of Mexicans may learn to understand us and become truly our friends as we have been theirs.

Learning the Value of the Metric System

GENERATIONS of effort by earnest advocates have not served to advance the cause of the metric system in the United States and in some other countries as have the world-war conditions of the last two years. This has been brought out by a survey of factory methods that has recently been made by the Bureau of Standards of the Department of Commerce, and by supplemental information in regard to new activities that is coming each day to this practical government agency.

American factories that knew only inches and feet twenty-four months ago are turning out millions of ammunition shells, rifles, guns and other war materials for France, Italy and other metric countries entirely in metric dimensions. Scores of railway locomotives are being manufactured by American plants in meters and millimeters, and in entire factories and sections of factories not a single gage, scale or other measuring device can be found bearing the complicated Anglo-American measures of length.

The orders in metric terms that are flowing into American factories are not alone for what might be termed primary war materials. In addition to locomotives, already mentioned, orders for rails, bridge members, machinery, tools, and even fabrics and wearing apparel, are accompanied by metric specifications. Practically without exception, American manufacturers have adapted themselves to the new requirement.

The experience has been a revelation to many manufacturers, who considered the metric system complicated because they had had no experience with it. Many practical workers have insisted that in spite of the handicap of unfamiliarity it is, in a very short time, a simpler matter to apply the metric system to their work than to use the foot and inch system, with its unwieldly fractions.

The war is helping the cause of the metric system in other ways as well. It has shut off South America and other consumers of manufactured goods from their usual sources of supplies in Europe, and has awakened in American merchants the desire to supply these markets, not only temporarily, but permanently. Practically every one of these possible markets, however, is in a country using only the metric system, to the people of which price-lists in pounds and tons, yards and inches, dozens and grosses, are hopelessly confusing. Furthermore, many of the South American countries require that goods be marked in metric measures before they may pass the custom houses.

The result of this is that exporter after exporter has recognized the need of making use of the metric system, and has quietly begun turning out two classes of products if he fills both domestic and foreign orders—goods measured and marked in customary units, and others sized and marked metrically. As complicated as such a procedure might appear at first sight, it has proved distinctly profitable in practically all cases in which it has been tried, thus confuting the contention of opponents of the metric system that its introduction would prove expensive.

How Can the Individual Be Prepared?

THE Preparedness Parade of May 13th in New York city was an impressive spectacle. There were in line above a hundred thousand men of all sorts and conditions, marching enthusiastically for an idea, with perhaps as many again for whom places could not be found, and a million or more spectators applauding along the way.

As a demonstration of the American state of mind this was magnificent; what shall we say of the physical side of the matter? The spirit was willing; what about the flesh? Leaving out of consideration the thousands of the paraders who were obviously men of forty or beyond, of whom first-class physical condition is perhaps not reasonably to be expected, the fact remains that the bulk of the paraders were young men. And the slouching gait and general aspect of weariness, long before the end of the march, of the bulk of these young men made it quite clear that not one in three of them could properly be passed by any surgeon of a volunteer regiment; that not one in six could, as he stood that Saturday, have entered our regular army; that probably an even smaller number would satisfy the demands of our naval examiners.

Just as a chain is as weak as its weakest link, so national preparedness can be effective only in proportion to the preparedness of the individual units. Millions of men willing to fight and unable to do so efficiently would constitute but a feeble national bulwark. It is plainly in order, then, to ask how our electorate can become fit for any possible demand of military service in the easiest and most practicable way, and with the least dislocation of the nation's daily affairs.

The answer is immediate. A bannered legend spread across the street above the paraders showed the way: "Join the National Guard. Call at any armory at any time." Contrary to a widespread impression, the duties are not arduous. A glance at the men who re-enlist and re-enlist, multiplying many times the term of their service, should be sufficient to dispel this notion. One night a week for seven months of the year given over to participation in the most healthful drills which experts can devise; rapid proficiency in the manual of arms and the rudiments of soldiering; practice in these things, with unlimited opportunity for physical hardening, at the summer camp; these are the things which the militia holds out. These are not detriments; they should be inducements. They are the things which make for individual preparedness, not alone for war, but likewise for the daily tasks of peace, for habits of vigor, of regularity, of effective action; in a word, for a sound mind in a sound body.

Electricity

The Telephone Industry and Dye Shortage.—According to the *Electrical World*, the shortage of dyes which in ordinary times come from Germany affects the telephone business to some extent. The pair of jumper wires used on the main frame of a central station formerly consisted of one white and one red cord; but from now on they will consist of one white cord and one white cord with a couple of red threads in it.

Silicon-Bronze Wires of 1,000-Foot Span.—In connection with the electric power distribution in Pomerania, a strait of the Baltic has been spanned by stranded conductors to a length of 1,000 feet. On each bank an iron mast 50 meters high has been erected. Each mast weighs 67.5 tons. The masts support three stranded conductors across the channel, which is about 950 feet in width. The conductors clear the surface of the water by about 117 feet at mean water level.

Convenient Series Resistance.—A manufacturer of starting and regulating apparatus has lately added to his line an adapter resistance, consisting of a resistance unit with a screw base plug at one end and a standard socket at the other. Thus a resistance can be conveniently inserted in any circuit that is served from the conventional type socket. It can be used for operating low voltage motors on a higher voltage supply, and for operating motors at slow speeds.

Rats and High Tension Switchboards.—Aside from the short-circuiting or grounding of overhead transmission lines by birds coming in contact with the wires, power companies are confronted with the problem of protecting switches and bus-bars from rats and mice. Recently, in an American power house a rat succeeded in reaching the interior of an oil switch and came in contact with the "live" or current-carrying members. Not only was the rat completely burned up, but the switch mechanism was ruined beyond repair.

Proposed Flood Lighting of Statue of Liberty.—A bill authorizing the New York *World* to raise, by popular subscription, $30,000 to install apparatus for the flood lighting of the Statue of Liberty in New York harbor, has been introduced before Congress. At the present time the statue is practically invisible at night, and its lighted torch attracts but little attention. For its efficient flood lighting it is estimated that light from concealed projectors to the intensity of from 6 to 12 foot candles will be required.

An Electrically-Operated Cleaner for Blackboard Erasers has lately been introduced by an American manufacturer. It consists essentially of a vacuum fan operated by a 1/25th horse-power electric motor. Not only is the chalk dust removed by the strong suction of the fan, but the surface of the eraser is cleaned by a rotating bristle brush. The chalk is drawn into a box, from which the air escapes through a fine muslin filter. It is claimed that no chalk escapes into the room.

Unusual Lighting Effects were features of the spectacular masque and pageant given in connection with the dedication of the new group of buildings of the Massachusetts Institute of Technology at Cambridge, Mass. Thirty-four 1,000-watt stereopticon projectors fitted with nitrogen-filled lamps were installed at intervals of 3 feet 3 inches on the roof of one of the buildings for the purpose of flood-lighting and spot-light effects, while a similar arrangement was installed on the roof of a facing building. Blue color screens were provided for twelve projectors of each group, red screens for nine, and green for a similar number. Among other lighting apparatus were four 1,000-watt projectors, each in a pit with a glass cover, for securing lighting effects in the central ring occupied by the performers; and four 250-watt units, also in glass-covered pits, for illuminating jets of water used in connection with the water dances. Numerous other lamps were used for flood-lighting the buildings and for other purposes.

A New Use for Electric Air Heaters has been found by the St. Marks Hospital of Salt Lake City, Utah. Heretofore a set of four dumb-waiters running from the basement to the first, second and third floors has been used for carrying food from the kitchen to the various wards. Great difficulty was encountered in keeping the food warm from the time it left the kitchen until it arrived at its destination. Now the hospital is using seven portable wagons designed by Mr. Chadron, general manager of the hospital. These wagons accommodate 26 trays and are arranged with sliding doors that make them practically air-tight. An electric air heater is mounted on the bottom of the wagon, with a cord and plug attachment capable of being connected 10 feet away from the wagon. An hour before each meal the various heaters are connected to a source of electric current in order to heat the interior of the wagons. After the wagons are loaded, they are placed on an elevator and raised to the various wards. If the meals are not to be taken immediately, the wagons are again connected to any source of electric current.

Science

The 1916 Bird Census.—The U. S. Biological Survey is now making its third annual count of birds, with the aid of volunteer enumerators all over the country. Each enumerator undertakes to count the number of breeding pairs of each species found on a selected area of 40 to 80 acres, and the count actually consists in an enumeration of the male birds found in the course of a few early morning reconnaissances. From the figures thus obtained estimates are made of the bird population in the various sections of the country. This year the Survey is making a special effort to secure statistics from the semi-arid, desert and mountain regions of the West, and also from the fruit districts of the Pacific coast and the South Atlantic and Gulf States.

Anomaly in a Prohibition Bill.—An interesting situation with regard to the Sheppard bill, providing for prohibition of the manufacture and sale of alcoholic liquors in the District of Columbia, formed the subject of resolutions by the Washington Section of the American Chemical Society, which are published in the *Journal* of the Washington Academy of Sciences. It appears that the bill was so drawn as to prohibit absolutely the use of grain alcohol for all technical and chemical purposes, not only in educational and private institutions, but even in the Government laboratories! It would even prevent the delivery, for analysis or other purposes, of samples and specimens containing alcohol. Worst of all, it would make it impossible for the Government to carry out many tests of food and drug products which are prescribed in the Food and Drugs Acts and the Insecticide Act.

The Rossi-Forel Scale of earthquake intensities holds its place in seismology on account of its simplicity and convenience, notwithstanding the well-recognized fact that it does not furnish an accurate estimate of the energy involved in earthquakes. A committee of the Seismological Society of America has recently considered the status of the scale, and has recommended that no modifications be made in it by the society on the ground that the subject is an international one, and alterations should only be made by the International Seismological Association. The society has, however, published several suggested modifications submitted by Dr. J. C. Branner, for the sake of bringing them to the attention of seismologists, and proposes to communicate these to the international organization. The committee suggests that the Rossi-Forel scale, whenever published, be accompanied by an equivalent dynamic scale, such as that of Cancani.

Bacteria in Candies.—An article by E. H. Cummins, in the *American Journal of Public Health*, describes investigations to determine the death rate of different pathogenic bacteria in chocolate candies. A mixture of sugar, chocolate and milk powder, after being sterilized, was innoculated with cultures of *Bacillus typhosus, B. coli, B. pertussii* and *B. tuberculi*. The samples were stored at a temperature of 68 deg. Fahr., and portions were bacteriologically examined at stated intervals. *B. pertussii*, the organism of whooping cough, disappeared within a few hours after inoculation; hence there appears to be little danger of the transmission of this disease owing to infection at the factory. The tubercle bacillus gave doubtful results, the possibility of long survival being apparently very slight. After long storage it was still possible to isolate the typhoid bacillus, and it seems to be possible for typhoid to be transmitted through infected candy if the worker should be a carrier. The colon organisms also survived for a long time, and if inoculated into candy would probably find their way into the body of the consumer.

What is "Fair" Weather?—Perhaps no technical expression used by the Weather Bureau—always excepting the word "cyclone"—is more often misinterpreted by the public than "fair." The history of the official use of this word is traced by Miss Eleanor Buynitzky in an article published in the *Monthly Weather Review*. Prior to the year 1888 the Signal Service (the predecessor of the Weather Bureau) used the word in reference to the cloudiness of the sky, a fair day being defined as one in which the average degree of cloudiness was intermediate between "clear" and "cloudy" (as measured in fourths or tenths of the area of the sky). In 1888 the term "partly cloudy" was substituted for "fair," in this sense, and the latter term was applied thereafter to a period without rainfall in excess of 0.01 inch. It appears, however, that as late as 1892 the instructions for voluntary observers retained the old definition. At present this word is used in forecasts solely to denote the expected absence of a measurable amount of precipitation. A letter from the director of the British Meteorological Office states that the term "fair" has never been officially defined in his service, though it is commonly used in British forecasts in application to a period without rain, and with a somewhat cloudier sky than is denoted by the term "fine."

Invention Notes

New Improvements in Lamps.—Peter Cooper Hewitt of New York, closely associated with electric light development, has been recently awarded a patent on a design of bulb for incandescent lamps, which overcomes the fault these lamps have in common with other systems, namely, that of uneven diffusion, more light being registered at one angle than at another. Dr. Hewitt's solution of the problem is in etching the outside surface of the globe in a series of small grooves, the surfaces of which act as refractors to direct the light to points deficient in luminosity. It is claimed for this innovation that the light is very agreeable to the eyes, as a broad surface of light is presented rather than a point from which the light emanates.

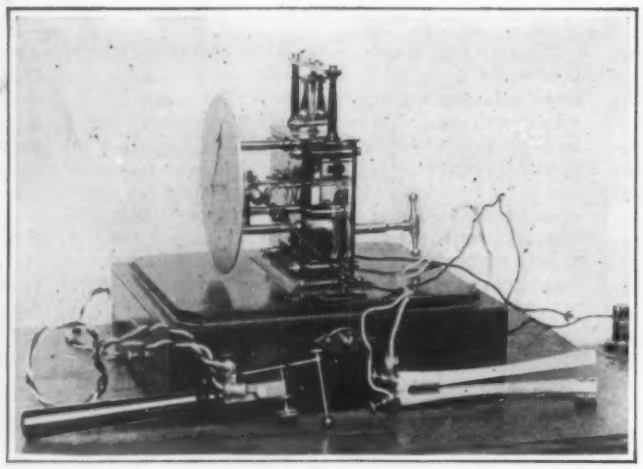
Safety Container for Blue Print Paper.—Those office persons who are compelled to handle blue print paper and tracing paper will be glad to know of a new device in the shape of a wall container which will greatly simplify the matter of handling the paper; and the person compelled to buy such paper will be interested to know that much of the material heretofore wasted by improper and careless handling will be saved. The case is hung on the wall, where it is always accessible. It is made of heavy metal of lengths corresponding to the standard widths of these papers. The fresh roll is put in place by pushing aside a slide, which is replaced after the paper is in place. The paper is now protected from the light and moisture of the air until the roll is entirely consumed. When it is desired to make use of a piece of the paper, a measuring tape mounted upon the case is drawn out the required distance and the paper comes with it. The paper is then torn off by means of a straightedge, which forms part of the holder.

Rail in Three Pieces.—An experimental test is being made on the Minneapolis, St. Paul and Ste. Marie Railroad with a new rail which is expected to show some economies over the old style. It consists of three separately rolled members which, being placed together, form the complete rail. The central section is shaped like the English bullhead rail and in place it is flanked on either side by "T"-shaped sections of such lines as to support the third section at points both under the base and under the head, the lower part of the central section being entirely inclosed by the other two parts. The outstanding sections are spiked down to the ties, but no other fastenings whatever are made use of either to splice the ends or hold the parts together in any way. By staggering the joints, the effect of a continuous rail is secured; but the great advantage claimed for this new arrangement is that the head, which is the only part of a rail subjected to any wear, may be renewed at a cost far less than that of replacing the whole rail.

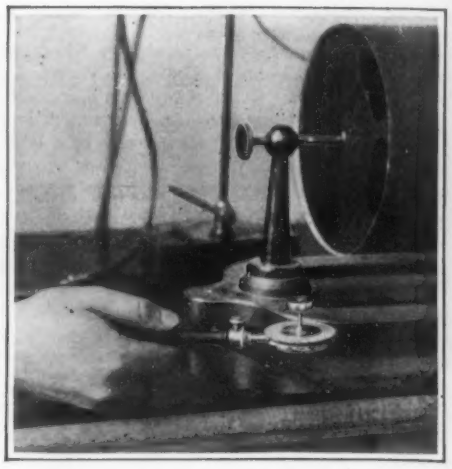
Correct Perspective in a Panorama.—The difficulties of securing a true perspective in the panoramic view seem to have been overcome by the invention of a "Visiograph," which has been designed by Sebastian Cruset of New York. This apparatus, which was recently patented, is an optical instrument intended for use by surveyors, artists and others. With it, a scene is viewed through a ruled screen of glass. Generally speaking, this instrument is designed to be supported before the eyes either by being worn like a pair of spectacles or mounted upon a suitable structure so that the view, scene or object to be sketched or accurately delineated, can be seen as if divided into sections, which can be reproduced section by section on a paper or canvas that is ruled in sections or fractional areas corresponding to those into which the view or object is divided by the visiograph. By the use of mirrors mounted on the device, the range of vision of the artist or surveyor is extended to cover 180 deg., if such a sketch is desired, or any part of this may be reproduced according to the pleasure of the operator.

A New Convenience on the Camera.—The convenience of the camera has been further increased by the addition of a means for accurately judging the actinic value of the light at the time of making a picture and thereby arriving at the correct length of exposure to be given the sensitive film. The improvement relates particularly to those cameras which carry a roll film. As these films are now made they are backed with a sheet of black or red paper for the purpose of protecting them from the light, and they have imprinted upon them numbers which appear under a tiny opening in the back of the camera and serve as a guide to the operator in properly spacing the exposures on the film. The new scheme, in addition, contemplates attaching to the backing paper, pieces of sensitized paper at regular intervals which pass along under another opening, and by observing the change which takes place in the color of these pieces as they are exposed under the opening, the operator is enabled to arrive at the length of time the shutter is to be opened in making the exposure for the desired picture.

Apparatus for vaso-motor test



The d'Arsonval chronoscope



Special apparatus for study of hand-trembling

Selecting Aviators

Psycho-Motive Examination of Candidates for the French Service

By Jacques Boyer

WHAT are the psycho-physical qualifications necessary in a prospective aerial pilot? How are these to be defined and measured scientifically? This is the delicate problem set themselves by Drs. Camus and Nepper, charged with the testing and selection of candidates for the French aviation corps. These gentlemen are devoting themselves to a series of methodical investigations of this matter, in which, by kind permission of the authorities, we have been permitted to assist, and which we propose briefly to describe.

Dr. Camus and Nepper commence by measuring with the d'Arsonval chronoscope the time of psycho-motive reactions of the candidate. In other words, they determine at what fraction of a second after having received a sense impression the subject reacts. The practical importance of these factors in the domain of military aviation is obvious. For suppose that an aviation pilot suddenly discovers, for example, a machine gun, which has been concealed from him up to that instant by the topographical features of the ground beneath him; how much time will he consume in the execution of a maneuver for the purpose of avoiding its fire? Or, if a violent wind threatens the destruction of his machine, how many seconds are necessary for him to put into operation the lever which will assure his retreat from the atmospheric danger zone?

The d'Arsonval chronoscope, employed in answering these questions, we illustrate herewith. In its essential features it consists of a clock dial divided into 100 parts, with a single hand. An electric circuit is so connected with the movement of this clock, by means of a steel spring, that while the circuit is broken the mechanism moves the hand at the constant normal velocity of one complete revolution per second, whereas the instant the circuit is made the spring contracts (under magnetic influence) and pulls the wheels out of gear, halting the hand instantaneously.

To measure the time of reaction of an ordinary stimulus, the observer seats himself before the candidate, holding in his hand a tiny hammer. By striking this hammer sharply against the table he at once gives the stimulus to which the candidate is to react, and breaks the circuit by means of an electro-magnetic

The emotion test

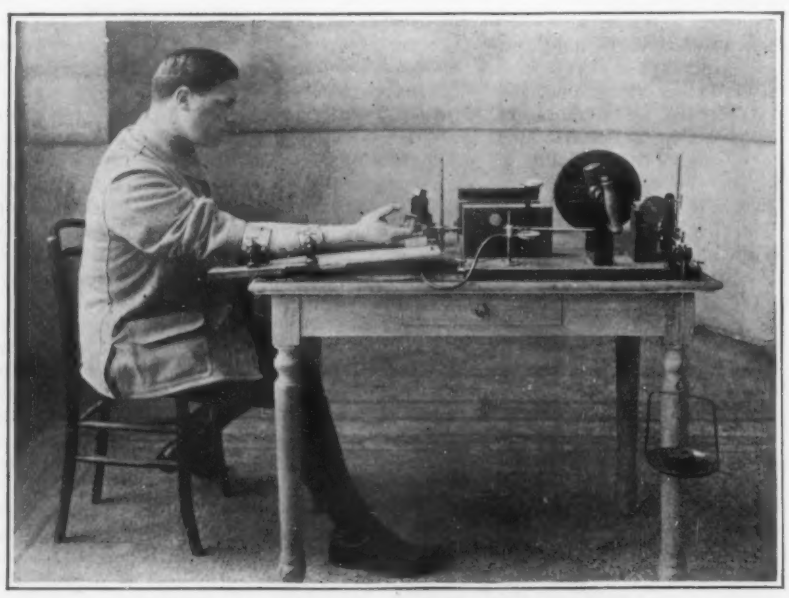
device connected with the hammer. The candidate holds in his hand a small metallic pincher. Immediately upon perception of the sound, he squeezes this together, thereby making the circuit again. The length of the interval during which the circuit was broken, representing the time of the subject's reaction, is read off from the dial by noting how far the hand moved during that interval—*i. e.*, while the circuit was open.

In entirely similar fashion the time of reaction to impressions of touch is measured; only this time the blow is struck upon the candidate's hand or the back of his head. Likewise the operations of the examinee's sense of sight are recorded by the doctor pressing the hammer gently on the table, the subject stopping the motion of the clock-hand as before directly he perceives this act.

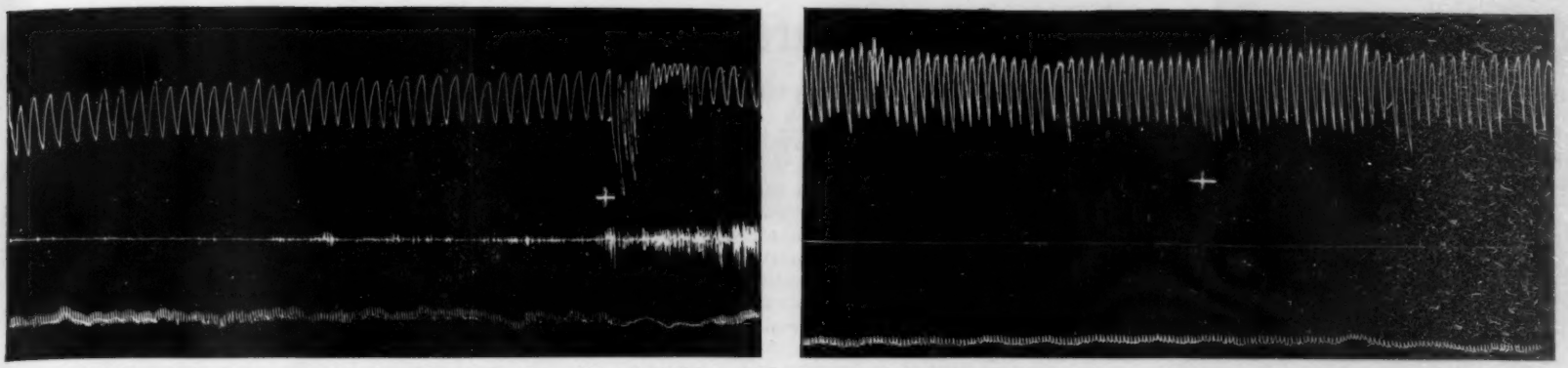
Application of these tests to a large number of candidates has established auditory and tactile reaction intervals of 0.14 to 0.15 second, and visual interval of 0.19 second, as a first-class performance. Candidates with auditory intervals greater than 0.17 second, tactile intervals greater than 0.20 second, or visual intervals greater than 0.22 second, are rejected as unfitted for aviation service. The slowest reaction intervals yet observed in candidates who are psychologically normal are, respectively, 0.33, 0.39, 0.48 second, for the three varieties of sense reaction, in the order in which they are mentioned above.

Drs. Camus and Nepper supplement the preceding data by determining to what extent the candidate's respiration and heart action are affected by his emotions; and also how his vaso-motor tension is modified, and what degree of muscular trembling is produced, by physical surprise and mental stress. A sort of recording stethoscope is attached to the candidate's chest. This instrument conveys the respiratory vibrations to an inked needle which records them upon a moving sheet of paper. By similar means the cardiac vibrations, the vaso-motor oscillations, and the trembling of the hand when supported only at the wrist, are recorded. After the candidate has been hitched up to all these apparati, as indicated in the cut, a revolver is unexpectedly shot off close to his ear, or a wet cloth suddenly applied to

Auditory reaction test



Determining fatigue index of candidate's fore-finger



Effect of pistol shot on respiration (above), hand-trembling (middle), and blood pressure (below). Good candidate at right, poor at left. Cross indicates moment when shot was fired

the back of his neck, and the effects of this treatment on his several functions under observation are read off from the graph. We reproduce a pair of graphs showing the respiration reaction of a good candidate, and that of a poor one, to the revolver shot. It will be observed that in the second subject the effects are not only much more violent, but of greatly extended duration.

Further interesting tests are designed to measure the degree of local fatigue induced by extensive strain on the hands and arms, and in particular by the long continued compression of the hands demanded of the aviation pilot. We illustrate the instrument employed in testing the endurance of the candidate's fingers. His arm and hand are so confined that only the one finger being tested can possibly do any effective work. To that finger is attached, by means of a cord running over a pulley, a scale pan with iron weights in it. A tooth gear furnished with a brake makes it possible for the candidate to raise this pan by contracting his finger, but prevents the pan from going down again when the finger is relaxed. This is necessary to obviate the fatiguing factor of shock from the descending pan, which could not be intelligently estimated. The candidate works his finger back and forth till it is incapable of further movement, whereupon the total weight of the pan is multiplied by the distance he has lifted it to obtain an index of fatigue for the finger in question.

In all these tests a standard of comparison has been established by application to a number of successful French aviators who have distinguished themselves during the war. It will be readily seen that the combination of rapid reaction with nervous imperturbability and physical indefatigibility demanded by aerial work is a difficult one; and the standard thus obtained insures against setting too high a minimum for the recruits.

The Parachute; Its Development and Its Role in Aviation

PROGRESS in minimizing the dangers of aviation has taken two directions. The designers are ever at work producing more stable planes, more reliable engines, more nearly perfect means of control. But with all this, planes do buckle, engines do stop, controls do fail, machines do fail. So that pursuit of the second path of progress, that of reducing the dangers inherent in an actual fall, presents itself as a necessity to all serious students of aviation.

In the course of the last ten years technical authorities have been turning more and more to the notion of a parachute as a fundamental part of the equipment of every aeroplane. This represents a distinct reversion to first principles; the parachute is the oldest means of aerial support known to man. As early as 1617, an Italian, Fauste de Veranzio, published in Venice a volume in which he illustrates the escape of a prisoner from a high tower by means of a rectangular canvas-covered framework, used as a parachute. The principle was likewise known to Leonardo da Vinci.

Whether Fauste's device received any actual trial does not appear; but late in the eighteenth century the principle of the parachute was clearly demonstrated by a group of Frenchmen. In 1783 Lenormand used two ordinary umbrellas in a successful leap from a large tree. Three years later Blanchard took a sheep up in a balloon and dropped it out on a parachute, the animal reaching the ground in safety. It would seem from this distance that the cautious experimenter incurred almost as much risk in adding the creature's weight to the load of any balloon he may have had at that early date, as he would have in entrusting his own precious body to the parachute; but man quails from the unknown dangers. Finally in 1797 Garnier was bold enough to make his experiments in person instead of by proxy, and achieved a parachute descent with no more serious injury than a sprained ankle, attributed to the violent oscillation of the parachute as it approached a landing. This difficulty he controlled partly in a later effort by cutting, in the apex of the parachute, a hole sufficiently large to relieve the violent air pressure from beneath the cone, without permitting enough air to escape to render the descent subject to the unhindered operation of the gravitational force.

The actual possibility of parachute descents now established, investigators began to seek a cure for the oscillation. An Englishman, Coking, in 1836 tried a combination of two parachutes, one erect and one inverted, joined along the outer edge; but the air slipped off the lower surface far too readily, his descent became a fall and he was killed. A few years later, in France, Letur constructed a most elaborate parachute, with sails, rudders, etc.; but in releasing it from the balloon it got entangled in the rigging, and the entire outfit plunged to earth, carrying the designer to his death.

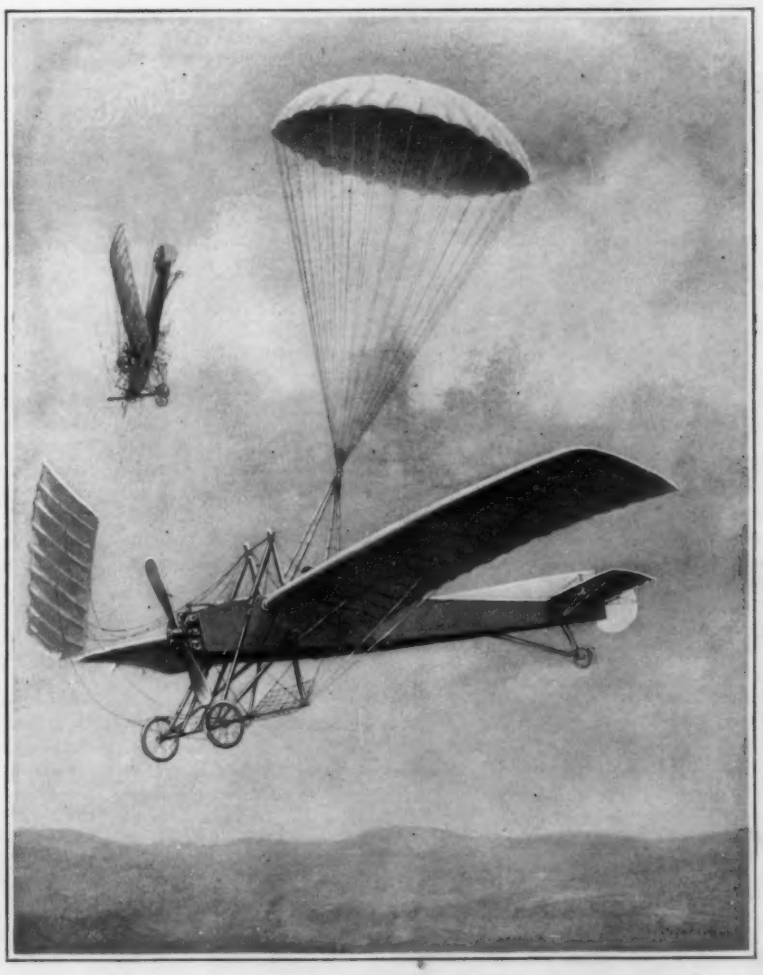
Shortly thereafter Leroux and his imitators introduced the well-known acrobatic parachute drop, in which after cutting himself free from the balloon the performer allows himself, for some seconds, to fall like a stone toward the earth before opening the parachute and checking his descent. This idea was scientifically a distinct step in advance, since it made certain the avoidance of any such accident as befell Letur. Its immediate effect, however, was unfortunate, turning attention from the parachute as a means of safety to the parachute as a spectacular adjunct to the circus and the county fair. The technique of parachuting was crystallized, and no additions were made to it save the trapeze performances with which individual parachutists might be inclined to feature their acts.

Since the aeroplane has become a serious factor, however, the parachute descent has again furnished a field for investigation. No great deal of definite progress over the models of 1850 has been made; but at least issues have been raised whose final settlement will go far toward making the parachute a definite feature of aeroplaning.

One of these issues has to do with the means employed for opening the parachute. The so-called rigid type is opened only by the air pressure from below which develops after the start of the drop, while the flexible type is opened by manipulation of certain mechanism by the passenger. The former type has the advantage that it rarely if ever refuses to work, while the flexible type now and again does so. On the other hand, the rigid type requires several seconds of sheer drop, after release from a crippled aeroplane, before it begins to open. In a short drop this may be fatal; *i. e.*, the parachute may strike the earth before it opens. For such a descent the flexible type may be safely employed, since the passenger opens it at will.

Since the one objection to the flexible type is its possible refusal to work, efforts are constantly made to devise an opening mechanism which cannot fail. Complete success in this would, of course, relegate the rigid type to the scrap heap. One extraordinary suggestion which has been tried out in Germany consists in the use of a mild explosive within the closed parachute. Detonation of this, either automatically by the act of releasing the parachute, or as a further action on the part of the passenger, opens the parachute.

The sustaining power of the parachute is astonishing. Expressed mathematically, the speed of descent varies as the square root of the weight of the load. That is, if a certain parachute will carry a load of ten pounds to the earth at a velocity of 1 foot per second, it will fall with a load of half a ton at a velocity of only 10 feet per second. It appears, then, that the problem of construction is merely that of building a parachute whose parts will sustain a given strain without displacement or rupture. The solution of this problem is all that is required for the realization of a parachute that will fall, with any given load whatever, at a moderate velocity. Even now the Germans are discussing the feasibility of immediate construction of a parachute that will salve not merely the aviator, but his machine as well—will fall, under the combined weight of an aeroplane and its pilot, at a sufficiently low velocity to deposit them on the earth's surface without serious shock.



Aerial salvage as it may be practised in the next war

Plastering Without Laths in Southern Italy

BUILDINGS in Naples and in the southern part of Italy, generally, are of "tufa," a soft or porous stone. The walls are, as a rule, from 1 to 4 feet in thickness and are treated externally with stucco work. Strips and laths are not used for interior work, but the wall to be plastered is first thoroughly wet and the first coat of plaster is then applied, having nothing to adhere to except the tufa. Later the putty coat is applied.

It is doubtful if there is an opportunity at present for the sale of expanded metal laths in the vicinity of Naples. Cement, however, for building purposes is coming gradually into use, the last figures available showing that in 1914, 2,392 tons were imported into Naples, compared with 1,721 tons in 1913.

Industrial Preparedness for Peace

New Opportunities for American Commerce and Industry

By Joseph E. Davies, Chairman of the U. S. Federal Trade Commission and Former Commissioner of Corporations

YOU have asked me to discuss briefly in this article "New Opportunities for American Commerce and Industry." It is with considerable trepidation that I venture to do so, for the subject is a very broad one. I am glad, however, to suggest a few of the salient features that occur to me.

Fundamental Bases for Unprecedented Prosperity and Opportunity

Opportunities depend upon conditions. So remarkable and extraordinary are the conditions which obtain to-day in industrial and commercial life that I venture the suggestion that we ourselves scarcely appreciate either the conditions that exist or the opportunities that are afforded.

Certain facts exist which are unique and fundamental in these conditions.

This nation is at peace in a world torn by colossal war. We are naturally protected in our isolation by two great oceans, each of which is held by naval experts to be the equivalent of a first-class battle fleet of any of the first-class powers of the world. For that adequate protection which we require for our national security by reason of this isolation, less capital is required to be taken from the productive lines of industry in investments in non-producing armaments and military preparedness than for any other first-class power of the earth.

An unprecedented volume of foreign gold has moved and is moving into this country. The Government mint has been taxed to the utmost. Six months of the year 1915 recorded at the San Francisco mint the receipt of ten times as much gold coin from Australia, Japan, and China as was received for the entire year preceding.

The gold coin and bullion in the Treasury has increased almost a third over what it was two years ago. We have, it is estimated, one fourth of the total gold coin of the world.

Our per capita circulation has increased within the year from $33.96 to $38.28.

Shipments of merchandise into this country have been practically constant during the last three years, but the balance in our favor of exports over imports is six times as great for 1915 as for the preceding year.

Within the year the individual bank deposits in national banks have increased 525 millions of dollars, an average increase of $5 for every one of our population.

Within the past year the total deposits in our national banks have increased 2 billion 198 millions of dollars.

The total resources of the national banks of the United States exceeded by 370 millions the greatest resources ever shown in the history of our national banking system, and showed an increase of 2 billion 270 million over the resources of these banks a year ago.

A recent report of the Comptroller of the Currency discloses that to the aggregate resources of the Bank of England, the Bank of France, the Bank of Russia, the Reichs Bank of Germany, the Bank of Netherlands, the Swiss National Bank, and the Bank of Japan there would have to be added the enormous total of 3 billions of dollars to equal the aggregate resources of the National Banks of the United States as of date of April 13th of this year.

Our national wealth is estimated at 212 billions of dollars, or 25 billions more than in 1912.

With one eighth of the population of the world, it is estimated that we possess nearly one third of its total wealth.

These are the basic conditions that established a period of the greatest domestic prosperity that this country has known. Our factories are working night and day; the standard of living and the wage scale of labor are higher than ever heretofore. Domestic requirements are constantly growing and cannot be supplied. What was regarded as a sporadic impulse in national prosperity has come to be recognized as a permanent condition that would exist by reason of these facts if dependent upon local demands alone. Fundamental conditions such as these must induce new opportunities for the future in domestic industry, quite independent of unusual or extraneous conditions. I shall not touch upon these further in this discussion, but shall seek rather to develop some of the exceptional conditions which have occurred to me in connection with the unusual time and circumstances which confront us.

Adaptation of Munitions Plants to Future Development

The most direct effect of the European war upon our industry was, of course, the demand made upon us by the warring nations themselves for munitions and supplies. One of the most significant developments in that connection at the present time is the extent to which manufacturers of munitions are engaged in scientifically appraising new industries, which may be available for and adaptable to the employment of their plants and their labor upon the completion or conclusion of war contracts. With admirable forethought this process is to-day being conducted, and the longer the war continues the easier will be the shifts of this kind into other lines of productivity and opportunity.

New Industries Projected by New Necessities

Supplies formerly furnished by warring nations have been cut off from our markets. This necessity has directed our enterprise into new avenues of opportunity and development. Probably the most signal illustration of this situation is to be found in the dyestuff industry. Prior to the war, of the total amount of coal tar colors used in this country, but one tenth, approximately, were produced here, the remainder being imported, principally from Germany. Such progress has been made, however, under the stimulus of necessity in the chemistry of coal tars that the annual output of crudes of the present American plants has increased tenfold over that of two years ago, and 33 companies are now occupied in the manufacture of coal tar intermediates, whereas the number of companies manufacturing finished dyes has increased from 4 in 1914 to 24 in 1916. Some fear has been expressed as to the possibility of destruction of this industry by unfair competition from abroad upon the conclusion of the war. There can be no reasonable doubt that adequate measures will be taken by the Government to prevent any such condition.

Many other lines of new industrial enterprise have been similarly developed. Test tubes, formerly made abroad out of American quartz, are now made here; novelty buttons; patented toys; chemical porcelains are now the subject of American manufacture, substituting previous foreign wares. The treatment of sealskins for American consumption, formerly done abroad; the extraction of certain forms of oil and certain bromides out of petroleum; the extraction of potash out of kelp, and its recovery as a by-product in the manufacture of cement, have all developed new possibilities and opportunities of permanent kind and character in our industry and commerce.

New Stimulus to Industrial and National Efficiency

Probably equally effective in the long run with these direct results will be some of the more indirect effects of these conditions. We have had demonstrated before us, with human life the subject of experiment, the value of efficiencies in industrial organization in the national life of warring nations. Facts, heretofore existing but either unknown or disregarded, have projected themselves into American thought and have stimulated our people into a realization of the necessity for greater scientific intensity, accuracy and economy in industry no less than in Government. The elimination of wastes in production, utilization of by-products, economies in distribution, closer calculations as to costs of manufacture; knowledge of costs of manufacture and distribution are all receiving closer attention. The utilization of by-products alone arising out of this scientific attitude of mind will doubtless be prolific with great opportunities. Wastes in industry due to economic conditions are being studied by Government agencies with a view to the conservation of resources and the more economic and efficient utilization thereof to the advantage of the nation as well as to the producer and laborer. Here, too, lie possibilities of great advantage in the development of stabilized industry under sane and efficient competitive conditions.

Foreign Trade and Epochal Opportunity for Its Development

The desirability of foreign trade is not open to question. The present constitutes a national opportunity for its acquirement. The greatness of our domestic market, the lack of pressing economic present necessity should not be permitted to retard its development. Many foreign markets have been cut off from supplies, even as have we, and are looking to us to supply their needs. Opportunities obtain now for our products to make easy access into the favor, customs and habits of foreign consumers. They may now acquire a momentum that will go far in offsetting the character of competition that is coming in the future. Permanent markets may now be easily developed. An illustration may be illuminating. Recently a particular brand of caustic soda, controlled by an international cartel, was used by the soap makers of South America practically to the exclusion of the competing American article. Necessity finally compelled the use of the American caustic soda, which was of a higher degree of test, and compelled the changing of process and formulae to its use, with the result that its superiority and economy have been demonstrated and a permanent market established. This is fairly typical of a very wide opportunity for American manufacturers' articles to become established in the habits, usages and customs of foreign users.

Coöperation to Develop Foreign Trade

Competitive conditions at home we can control. Abroad, we have to meet conditions as they are. From careful investigation and study, it can be stated that foreign combinations and cartels, both of a national and international character, in international markets, have prejudiced the development of American foreign trade. Should coöperation among American manufacturers and traders in the foreign field, to meet this character of competition, be authorized and encouraged by law, as recommended by the Federal Trade Commission to this Congress, many opportunities will be afforded to the concerted action of small manufacturers of this country who cannot now afford to push their wares individually in foreign fields. A specific instance may illustrate. In certain countries of South America, Pacific coast salmon are sold under a British brand, and have practically dominated the market to the exclusion of equally good American brands. This is due entirely to lack of propaganda and exploitation of the value of salmon by American interests. Coöperative effort could relieve and change this condition. This is true of American lumber, coal and many other of our products.

South American Securities and Foreign Opportunity

In the development of foreign markets, the ownership by nationals of railroads and public utilities has a marked effect upon the development of foreign sales. Great Britain, Germany and Belgium have heretofore furnished nine times as much of the railroad supplies of South America as have the United States. Similar conditions have obtained with reference to electrical and other kindred supplies. The competition is of a national character and is not individual, and is much controlled by investments of this character. It is estimated that approximately three billion of dollars of securities of South American railroads, public utilities, and other public service corporations are now held in Europe. These securities have generally been maintained to be more stable and secure and permanent than the securities of the Governments themselves, and will probably be absorbed in large quantities by American investors. If so, that fact will undoubtedly tend to enlarge opportunity for manufacturers of American supplies.

Shipping Facilities the First Prerequisite

Opportunities in foreign trade are dependent to a greater extent upon shipping facilities than upon bank connections or any other single factor. The lack of ships and shipping facilities between South America and the United States has been and is the most serious impediment to the development of this commercial relation. It is notoriously urged in South America that American goods are discriminated against both in freight rates and in terms of delivery when carried, as they must necessarily be, by ships owned by other nationals seeking the same market. Cement, it is stated, is quoted cheaper f.o.b. New York, grade for grade, than f.o.b. Liverpool to importers in Argentina. But this advantage to the American manufacturer is immediately offset by the differences between ocean freight rates. Whether this allegation of intentional discrimination is well founded or no, it is a well-known fact that for many years a combination has existed between the different British lines of steamships running between the United States and various ports in Brazil, Uruguay, and Argentina. Some time ago, under the terms of a tariff treaty, Brazil allowed certain American goods to be imported at a lower rate of duty than that allowed on similar goods imported from other nations. This should have accrued to our advantage, but when the time came for the tariff to go into effect the combination or so-called Conference Lines controlled by foreign rivals raised their freight rates on such commodities from the United States to an amount that was sufficient to absorb the advantage intended to be conferred by the preferential tariff.

(*Concluded on page* 28)

Lessons of the Battle of Skagerrack

Supremacy of the Dreadnought, Inability of the Battle Cruiser to Stand Punishment, Usefulness of the Destroyer

By George Dewey, Admiral of the Navy

By Courtesy of "Sea Power"

THE most titanic clash of sea forces in the history of the world took place off the mouth of the Skagerrack, on May 31st, between the German and the British fleets. From a naval standpoint this is the most interesting event in the present generation. Its importance is not so much due to the results one way or another in advantage to the contestants as in the lessons it teaches with relation to the qualifications in actual combat of those elements that go to make up the modern fleet.

In the battle of Skagerrack great armored dreadnoughts came to grips for the first time in the history of the world. In that fight the battle-cruiser played its part for the first time in a pitched engagement. Light cruisers were in the midst of the fighting, and battled and died. Those daredevils of the sea, the destroyers, for the first time in history closed in on first-class ships in broad daylight to drive home their torpedoes and take their one chance in a hundred of surviving.

In fact, a modern first-class fleet, with its various units, went to grips with an enemy of its kind and tested its qualifications. All these fighting machines of the sea have heretofore been creations of theoretical but somewhat untried efficiency. The day of their test was May 31st. The showings of that day will have much to do with the fleets of the future built by all nations of the world.

Just what happened at Skagerrack is not yet clear, and conclusions drawn from that fight are made from incomplete evidence and may easily be upset. But two weeks after the fight it would seem that something like the following happened:

Fought at Short Range

The German fleet was feeling its way to sea, looking for an opportunity to strike a blow with conditions to its advantage. The British fleet was spread out over three hundred miles of the North Sea. The day was hazy and a ship could not be made out more than six miles.

This necessarily short range was to the liking of the Germans. Their fleet was concentrated. They determined to give battle.

Destroyers and trawlers make up the advance line that the British draw across the North Sea. Back of these are the fast cruisers. Still farther back and subject to call are the battleship squadrons.

The advance line reported the presence of the German fleet. The British were anxious for a decisive battle. The battle-cruiser squadron immediately closed in. It was nearer than the battleships and had thirty knots of speed against their twenty, so it got into the fight first. Battle-cruisers were not intended to fight battleships, and it was suspected that German dreadnoughts were ready for action. Admiral Beatty, however determined to attempt to hold the German fleet until the British battleships could come up. He therefore went in with his battle-cruisers.

It appears that three of his ships went to their death early in the fight because of this attempt. The "Queen Mary," the "Indefatigable," the "Invincible," as dashing ships as ever put to sea, were sunk. It would seem, however, that they inflicted losses upon the enemy that made their sacrifice worth while. They evidently succeeded partially in their purpose. Some of the British dreadnoughts did not get into the fight.

But the lesson is this: Battle-cruisers, with the weight of their armor sacrificed to speed, with fewer big guns than have dreadnoughts, cannot give and take with the latter class of ships. In grips with dreadnoughts they are pretty sure to be sunk. This has been the theory of naval experts all along, but that moot question of the point to which armor should be sacrificed to speed has never before had any actual experiments upon which to base its deductions.

The battle-cruiser was crumpled up and its unfitness to play a leading rôle in naval dramas was demonstrated. The "Queen Mary," a magnificent ship of her kind, dispacing 25,000 tons, could not survive the big shells of the Germans.

The Dreadnoughts Arrive

This was the first phase of the battle. It seems to have been after the sinking of these three ships that the British battleship squadron, led by the "Warspite," arrived. There were four ships in this squadron, and they plunged into the midst of the fight. They appear to have found a fleet that greatly outnumbered them. They unquestionably came in for a tremendous amount of hammering. Every vessel was struck many times. The "Warspite" and the "Marlborough" both suffered many serious hits. The "Marlborough" was torpedoed. Yet neither of these ships sank, both found their way back to port and both will soon be back in the service.

Captain Phillpots, of the "Warspite," tells a thrilling tale of the experience of his vessel and the punishment she took. His steering gear went wrong and his ship got out of control. She plunged into the midst of the enemy fleet. She drew the concentrated fire of six enemy battleships at one time. She ran amuck and sought to do all the execution possible. Her every gun worked to the maximum.

Yet she stood her punishment and came through. She served the purpose for which a big ship is created. She proved the fitness of herself and her class to perform the purpose for which dreadnoughts are built. She proved the correctness of the theory of those experts who have held that it is wise to sacrifice much possible speed for heavy armor and big guns.

The "Warspite" is a vessel readily comparable with our own "Texas" and "New York." She has a similar displacement, 27,500 tons. She has eight 15-inch guns where the American has ten 14-inch guns. She is four knots faster than are the American ships and her endurance is probably less. What she did American dreadnoughts should be able to do.

The "Marlborough" is a 25,000-ton ship, of about the class of our "Arkansas" and "Wyoming." She, too, stood a vast amount of punishment, including that of being torpedoed. This latter test of a modern battleship is very interesting. A number of fighting ships have been sunk in the present war by torpedoes, but they were mostly old vessels and without the resistance of the newer ships. The impression that a torpedo is sure to prove the undoing of the dreadnoughts has not yet been demonstrated, and the survival of the "Marlborough" tends to prove it.

Destroyers Attack in Daylight

A third and most interesting phase of the battle of Skagerrack was the attack of destroyers on both sides. These tiny ships, which were intended to serve the purpose of a screen, to be outriders and scouts of the big ships, had currently been regarded heretofore as being incapable of attacking first-class ships in the daytime. Their method of attack was set down as being one covered by darkness or by fog. Under these conditions destroyers are intended to creep in on the big ships, unleash their torpedoes, and attempt to escape before they are sunk.

It had been known that the Germans had practiced day attacks with their destroyers. This was a possible use of destroyers that neither American nor British fleets had given much consideration. In the North Sea battle, however, before darkness came on, the German destroyers descended upon the British fleet, got in close, and discharged their torpedoes. It is believed that a score of them were sunk, and it is probably true that they did not succeed in destroying any British first-class ship. They unquestionably came near getting the "Marlborough," however, and it is not shown that such an attack did not prove strategically advisable.

It is believed that the British fleet responded by sending its destroyers into the midst of the German fleet under similar circumstances. Certain it is that something near a dozen British destroyers were lost. The returns do not yet indicate what destruction these vessels created in the German fleet, and it is therefore not possible to draw conclusions as to whether their sacrifice should have been made. The fact remains that destroyers played a very important part in the fighting and were active throughout the engagement. The usefulness of these small ships in a great struggle such as that which took place off Skagerrack is regarded as having been demonstrated.

A point of intense interest to the general public in this first big sea fight of modern navies is the high rate of loss of life aboard ships sunk. On the "Queen Mary," the "Indefatigable" and the "Invincible" there was hardly a man saved. Already the United States Navy Department is receiving great numbers of letters from individuals who have suggestions to make as to devices that might be used for saving lives aboard fighting ships. These individuals seem to draw the conclusion that no precaution is taken aboard a battleship for saving life in case the ship is sunk in battle. This is not true. When a battleship is stripped for action there is certainly no place on her deck for boats that might be used for life saving. She has aboard, however, pneumatic rafts, and every man has his pneumatic belt, which would keep him afloat.

All Die with Their Ship

In time of battle, however, there is no time and no inclination to make use of these devices. When a battleship is hit and seriously damaged there is no way of knowing whether or not she is about to sink. It may be possible that she will remain afloat for hours, or that she may not sink at all. Her purpose is to continue to damage the enemy to the greatest possible extent. A single final shot from a sinking ship may be the blow that will turn the tide of battle and the destiny of empires.

A damaged battleship, therefore, continues to fight. The men remain in the fire rooms, in the turrets, at their guns. Every man continues that particular job which is his in fighting the ship as long as she may strike a blow. It therefore happens that when the battleship goes down there is practically nobody on deck, and there is no man who may leave his post in time to put on a life belt or launch a raft. Quite naturally, every man dies with the ship.

The theory of fighting the ship until the last moment seems to have been exemplified by practically all those that were sunk in the recent battle.

The battle of Skagerrack seems to have justified the position which has long been taken by the experts of the General Board of the American Navy, a position which has met the approval of most American authorities and which has been crystallized into the programme which America has followed. The General Board has recommended for fifteen years that the United States continue the policy of placing its chief reliance in big ships. Since the dreadnought came into being it has maintained that that vessel should be made the backbone of the fleet. If appropriations were sufficient to provide but one class of ships, the General Board has insisted that they be dreadnoughts.

American Programme Justified

There is a constant tendency on the part of the public to go off at a tangent in its enthusiasm for the class of ship that at a given time is attracting wide attention. Last fall, for instance, the public clamored for many submarines and favored disregarding appropriations for dreadnoughts or battle-cruisers. Later, the battle-cruiser has been attracting much attention to itself because the incidental clashes of the present war have been battles between scout ships. So the clamor this spring has been very largely for battle-cruisers.

The dreadnought has attracted very little attention because she has not heretofore been in the fighting. The public did not see that the very existence of British dreadnoughts in the North Sea resulted in the bottling up of all Germany. It did not generally realize that the battleship was performing its purpose without the necessity of fighting. The present clash, however, demonstrates that in the final issue it is the dreadnought which means victory or defeat.

This battle seems also to have proven the value of that other branch of the fighting fleet which has been given most attention in the American Navy, the destroyer. The many opportunities for usefulness of and the great possibilities of execution which rest with these little ships seem to have been demonstrated. The battle of Skagerrack seems to have shown that the United States has chosen wisely in selecting the units upon which she would depend in making a fleet from appropriations that made it impossible to have all the units desired.

The usefulness of the battle-cruiser or the scout cruiser has not been disproven, but the inadvisability of depending upon the fast lightly armored vessels in a clash in which dreadnoughts are engaged is shown. The cruiser is a necessity in any modern fleet unless that fleet is willing to grant certain advantages to its rivals which are provided with these fast ships. The theory that a time would come when they would displace dreadnoughts must, however, in the face of the new facts, be given over.

The battle of Skagerrack teaches less of the value of guns of various calibers than of most of the vital problems of the navy. All the fighting was close in. The marksmanship was, therefore, not very exacting. The test on the guns was not great. Any gun and almost any gunner ought to be able to make hits at six miles. The advantage attributed to British guns and gunners had little opportunity to demonstrate itself. Likewise are the results in ships sunk by the British cruisers and dreadnoughts still unknown. The deadliness of the great British 15-inch gun cannot yet be said to have been determined.

On account of the deficiency of protection against discovery, this tented field is not difficult to see a mile above

A camp of the older type of brown Sibley tents. The trees might be a partial protection against observation, but not enough for safety

Passing of the Tented City

How the Aeroplane Scout Has Affected the Military Camp

By Edward C. Crossman

THE aeroplane is with us apparently to stay, and with it a long list of evils and virtues with which we are not yet entirely acquainted. By means of the winged demon, the enemy is given the much-sought but often missing elevation of view by which to spy out our doings. Better by far than the bird's-eye view of Kenesaw Mountain, the flimsy contrivance of cloth and guys and humming motor lets us look directly down on the other fellows, and beat them to whatever particular bit of pleasantry they may contemplate.

Prying into the affairs of the other fellow seemed to be the province of the military aeroplane in the early days of its use. Now, since the other fellow has resented such prying, and has taken means to pull down the shades—rather to pull over the shades, the function of the plane has become the beneficent one of allowing high explosives to drop wherever conditions indicate that the enemy will be particularly peeved at the receipt thereof.

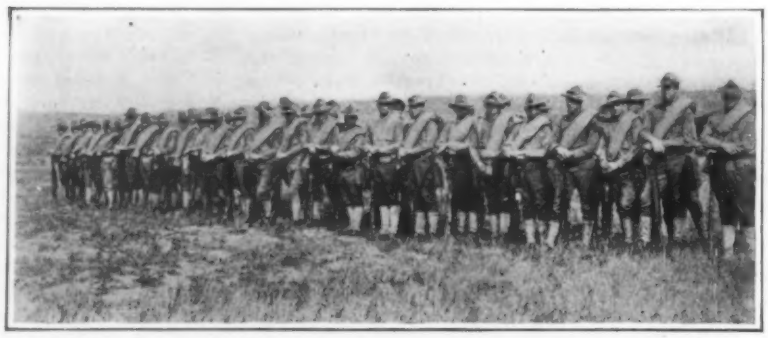
Indications that an ammunition factory is busy or that a battery is on the march or that the troops are comfortably packed in sufficient number to make the covey worth a shot, provoke attention from the first hostile plane that passes by, and has a supply of explosives.

One result of this state of affairs is that the army tent will have to go, save at bases a long way from the possible attention of aeroplanes. The alternative—save that of being blown around the surrounding vicinity—is that of coloring the tents to harmonize with the background upon which they happen to be pitched, and this truly is a task for a chameleon, not a tent dyer. Correspondents with the Allied troops in France tell of the tents, and the temporary structures for the shelter of troops, painted in cubist colors to deceive hostile planes into fancying them merely part of the general scheme of the landscape.

The tent is far more common in this country, thinly settled, and with the work of its troops in the past in sections where no houses at all existed, than it is in Europe, where the villages lie within gunshot of one another, and where billeting troops for the time on the villagers is by far the most common way of putting them to bed for the night.

So far as I know, the shelter tent is not a part of the outfit of the German infantryman, and the German equipment we may regard as being as nearly ideal for the conditions of Europe as it can be got by men who have for a half century thought war by day and dreamed war by night.

The familiar American Sibley, and the later adaptation of that type into a four cornered tent, seems to be very much unknown in the French and German armies. The British know more of it, because, like American troops, much of their work is in districts where it was canvas or nothing for shelter.



An infantry company ready to march with the old type pack; the outside of each roll is a half-tent

The shelter tents of American infantry for use of two men. Half of each tent carried by a soldier

A trench, built, occupied and abandoned by Mexican regulars, taken just after removal of the dead; the simple, childlike type of trench that goes with the old type of tented camps

Without question, a camp of the old familiar American type, with miles and miles of the brown topped Sibleys, and the more or less dirty, white old style tents inseparable from the large camp, would cause the aviators of the enemy to chortle with the joy that possesses the hunter when he marks down the alighting place of the fifty-bird covey of quail. Easily seen, impossible to miss, and with every shot killing a hundred men or so, a brigade camp of the old American type would simply delight an enterprising aviator of the enemy side. Of course a bomb dropped on a building occupied by a number of soldiers would create as much havoc as any bomb dropped into a camp, but enemy planes cannot go about blowing up every edifice on the landscape, and usually the presence of soldiers in any particular one or group, would not be advertised. Then there is of course the reversion to aeroplane first principles, the easy estimate of the availing strength of the enemy by his camps.

The American infantry private carries in his pack, half of a small shelter or "pup" tent, which, buttoned to the half carried by his comrade, makes a very complete, and very waterproof little tent, holding two men. The later types use the rifle, and a bayonet as tent poles; the older types, still much in use in the militia, were set up with jointed small poles carried in the pack. The tent, set up, is waist-high, 6 feet long, and about 4 feet wide.

The camp of a single regiment of 1,500 men, spreads itself over a space of 900 x 900 feet, or 19 acres. A brigade uses up 60 acres for its tent space. An artillery brigade uses up 100 acres. Here it would be particularly bad, because 100 acres of shelter or other tents, and guns, and caissons and limbers would advertise itself like an electric sign, and invite the destruction of the most potent and hard to replace arm of the service. Such a camp would be impossible to miss in overlooking the country, and as impossible to miss with bombs. A division, the smallest unit considered in modern war, where whole armies are used to deliver mere feints, occupies 400 acres of ground.

It is rather obvious, even to the cursory follower of the progress of European events, that spreading out such an exposition and such an invitation as this within 50 miles of the fighting lines would be to tell the other fellow a lot of things

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British Admiralty speed test of an American tractor biplane. The machine made a speed of 83 miles per hour, fully loaded, with 4½ hours fuel supply and carrying a pilot and passenger

Our Blind Army

Precarious Condition of the United States Army in Aeronautical Equipment

FOR the immediate present at least, the United States Army is an eagle without wings; or, perhaps, to be more specific, an army without eyes. The provision for Army aeronautics at the present writing would make our Army rank thirteenth in the aerial forces of the world, coming behind England, Germany, France, Russia, Italy, Austria, Turkey, Bulgaria, Spain, Portugal, Switzerland, and the Netherlands—and this notwithstanding the fact that the United States Army acquired the first aeroplane in 1909, two years before any other nation, while the Navy acquired the first hydroaeroplane in 1911, with the other nations following suit several months later. However discouraging present conditions may be, every indication points to the fact that they are but temporary: an efficient aeronautical arm is bound to be a prominent feature of any preparedness programme.

Whatever pride we Americans may have entertained toward our fleet of eight scouting machines which was sent to the border to participate in the punitive expedition into Mexico some three months since, three weeks of actual service was sufficient to convert the machines into a pile of junk and our pride into shame at the poor showing of the aeronautical branch of the Army. In all fairness let it be said that if the materiél failed miserably, the personnel did well indeed under the tremendous handicaps confronting it. No end of difficulty was experienced by the Army aviators flying in the rarefied air of the Mexican plateau; and the motor of 80-horse-power rating on each tractor biplane was found totally inadequate to the requirements. Thus in three weeks' time the soldiers found themselves without air scouts—without eyes, in a modern military sense—despite the fact that the enemy had not used anti-aircraft artillery nor a single aeroplane to hasten the fleet's end.

Now the Army has in commission twelve tractor biplanes, fitted with 160-horse-power engines and capable of carrying a pilot and passenger and 200 pounds of useful load, besides sufficient fuel for a flight of 4½ hours' duration. These machines were hurriedly sent to the border to replace the original fleet of eight. Aside from these machines which are actually available, the National Guard of several States have formed aeronautical companies possessing one or more machines and a personnel more or less trained in the plain art of flying. It would be difficult to estimate how many machines the Army can immediately count on from this source, for many of the National Guard aircraft are of questionable usefulness for actual service; but it cannot be denied that several of the machines would be a welcome addition to the present Army fleet, particularly such excellent machines as the twin tractor 180-horse-power battleplane, which recently flew from New York to Washington and is now at the Mexican border in the service of the New Mexico National Guard.

Aside from the 12 machines now at the border with the Army, three more are contracted for. Allowing three aeroplanes for each aviator—the number allowed by European countries because of the rapid deterioration of aircraft and for the reason that while one is being flown, two others are being repaired—there is really only sufficient equipment for five of the fifteen aviators who are now with the expedition. Admitting that no spectacular aerial battles are likely to take place between Mexican and American aviators should war occur, in view of the difficult and extensive terrain of northern Mexico, the five air scouts will prove absolutely inadequate for military purposes. Furthermore, aside from protecting the Army the aircraft are to be called upon to protect the people living along the border, from Mexican raids. But how can so few machines patrol a border line of over 1,500 miles in length? Even with the machines of the National Guard the

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Inspection of completed fuselages before shipment to Europe

Fuselage assembling room of an Eastern aircraft manufacturer

Wing assembling room of an American aircraft factory

Assembling department, showing a tractor biplane in building

The Field for New Achievements in the Motor Vehicle Industry

Improvements that May Yet Be Made in Automobiles

By Marius C. Krarup, Member Society of Automobile Engineers

FOR some years it has been a prevailing impression that in the matter of automobile design and construction there is not much more to be done for the benefit and convenience of the public; at least not much of vital importance. None the less, the development spread before visitors at the recent automobile shows in New York and Chicago was astonishing in variety and in many respects promising of still better things. The question again arises: With so much accomplished, what more will manufacturers be able to offer? What more can there be to occupy automobile engineers and inventors?

However interesting, the question goes without an answer so long as the most competent are least willing to venture upon predicting the future. But a middle course can be taken by mentioning what must be or should be, if the logic of events, of popular demands and of mechanical possibilities count for anything, rather than proclaiming what will be. On this plane a sketchy list can be given of the more important tasks still remaining to tempt the inventive advance guard of the motor vehicle industry.

The Light Car

Light weight for large and spacious cars is one of the cries of the hour. The best small cars are lively on the road and cost little for tires, gasoline and oil, simply because they are light by virtue of their small size. They have raised the popular demands and expectations. Defying contrary reasons, people now want a large car with the economy of the small one, and speedy and lively besides. To make the large car light is the only way, or at least the most obvious way, to meet this demand for more luxury and more economy combined. The luxury can be enjoyed by making the motor very powerful to handle the big weight, but not the gasoline economy, which it has become a fasion to insist upon, nor the tire economy, which is really more important, as the tire injuries due to large weight cause inconvenience as well as expense. Large and heavy cars have been pounding over the roads for a good many years, usually with springs and tires which were not very suitable, and when they pounded themselves out of running order the easy remedy was to make some part stronger and heavier. Despite improved steels, they grew heavier every year, to be quite safe against troubles and to carry a more luxurious heavy body and equipment. Motoring became more expensive. They have come to the turning of the long lane. The order of the day is now to make them pound less heavily by means of more suitable springs and tires, to reduce the size of the motor and to trace a safe path back to much lower weights. Careful new design of every detail, more alloy steel, more aluminum instead of steel are the watchwords. But every one of these expedients spells a higher production cost for the present. The problem remains of making large cars light, the bodies fully as much as the chassis, without paying for their driving economy in their purchase price, or else of making light construction superfluous by removing the objections—high fuel and tire expense—to the heavier construction which is now the rule.

Carbon Deposits

Carbon deposits in the motor cylinders, which have to be scraped or burned out every now and then, cause progressive little troubles while forming. This evil has grown in importance in the measure as the working speed of the gasoline motor has been increased. The deposits are due to the exposure of heavy lubricating oil to the heat in the cylinders. The oil is not quite burned up but is "cracked"—as happens to kerosene in a smoking lamp—leaving a soot which mixes with the incombustible particles in the road dust. The dust is sucked into the cylinders through the carbureter. No oiling system has yet been devised which obviates this trouble completely. The use of very fine and pure graphite in the oil reduces it greatly but leads to clogging of all fine ducts if oil with a trace of acid happens to be employed.

Carbureters are being improved and adapted to new motors all the time, but no provision has yet been made for making them work with clean instead of dusty air, and they are still inferior to steam throttles in responding to the driver's desires. The steam throttle, when opened, at once admits steam at the new rate that is wanted, but the carbureter has to be nursed for a few seconds from one rate to another, especially when the motor is relatively cold. Only lately, and by means of an auxiliary device, has a water-cooling system been devised which keeps the motor at an even temperature, independently of its speed and the force of its explosions—which is a matter of the greatest importance when any other fuel than the most volatile gasoline is used. If American motors and cars are to be sold broadly in countries where benzol and alcohol are, or will be, the preferred fluids, a considerable development on these points will be indispensable.

There is still no windshield that gives protection as well as a free view for the driver when rain or snow is beating against it, and while this is apparently a minor matter, and partly remedied in some of the shields, it yet craves a solution. The same knotty little question comes up in driving a closed car from the inside.

Springing of Pleasure Vehicles

Because doubled speed means quadrupled jolts on the road, automobiles have not only steel leaf springs, but also friction or resistance elements which help in absorbing the jolts while keeping the movements of the springs and the vehicle within the bounds of comfort. Great progress has been made in the "springing" of pleasure vehicles, as here the load ordinarily does not vary much and does not constitute a very large percentage of the weight of the vehicle, but the field is wide open for improvement in the spring equipment for omnibuses and all utility vehicles. Their rumbling, rattling and bouncing are expensive as well as disagreeable signs of incomplete construction. The combination of spring steel, confined air and hydraulic friction will do all that is wanted, while also saving weight and cost, but it has not been mastered yet.

The most self-evident shortcoming of all motor vehicles, from the owner's standpoint, has always been the inconvenience of their oiling system. The amount of watchful care and humdrum work needed for keeping every working joint in serviceable condition, in conjunction with the mechanical penalties incurred if the work is neglected, has survived as a baneful tradition from machinery and locomotive practice. For the first time in the history of the automobile industry two cars—one imported from Ireland—have now been exhibited at the New York Show in which all oiling takes care of itself for six months, if the crankcase is kept supplied with cylinder oil. The example will stimulate improvement of the same kind, but there is a large scope for both failure and success in trying to make such a comprehensive and automatic oiling system simple and absolutely dependable, as it must be, without interfering too much with the rest of the car's previous construction, or its cost.

Increased Use of Aluminum

A mere glance at metallurgy opens surprising vistas. Nickel was the most trusted alloy metal for steel twelve years ago, but now chromium has worked itself to the front on its merits. To remove impurities and bring about that close adhesion among the steel crystals which secures against microscopic flaws and means lasting strength, the once very rare vanadium is used, but the electric furnace—through the control and intensity of its temperatures—accomplishes the same purpose as well as the greatest advance in the possibilities for thin and perfect castings in almost any alloy. And now cobalt, mined largely in Ontario, looms up as a wizard material. It goes into the highest grades of high-speed steel, for tools, and has revolutionized the uses of aluminum. It makes steel non-corrosive and silvery, yet does not spoil its ductility in certain combinations. It is bound to hold the stage for new developments for a while. With non-corrosive sheet steel and strong ductile aluminum produced at natural cost and marketed at natural prices, miracles in light and strong construction can be accomplished. The chemical industries work hand in hand with these possibilities by producing plastic and fibrous substances which can be enlisted for constructive use in automobile body work, to kill vibration and tiny clatter, to enhance rigidity, to insulate and protect, and to afford wearing surfaces more agreeable to the touch than metal.

Some of the most interesting needs are generally ignored in automobile circles for the thoroughly practical reason that no means for meeting them have as yet appeared above the horizon. To recognize them and to form the conviction that sooner or later they must be met, it is only necessary to get them into the mental vision.

Skidding

Traction chains—sometimes called mud chains—are recognized as necessary with pneumatic tires and with smooth solid rubber tires in order to avoid skidding when the road surface is slippery. In practice there is the choice of using steel-studded tires on at least two wheels (preferably left front and rear right) all the time, or else using traction chains during and after rainy weather. The effectiveness of steel studs is reduced by wear, and America prefers to put the chains on and take them off again as needed. But it is inconceivable that this practice should be kept up forever. The objections to it, both practical and esthetical, are recognized in the reluctance with which it is followed. Eventually, if roads are not so improved as to give traction for all kinds of wheels in all weathers, automobile wheels must be so developed as to give traction on all kinds of roads. The nearest possibility lies in devising simple means for driving with all four wheels of a vehicle, instead of with only two, because four-wheel-driving is already known and helps greatly in avoiding skidding. Simplified four-wheel-driving—which may be materialized in a dozen different ways before the best is evolved—would need but little help from wheel or tire construction to make traction secure at all times.

Old men remember the days when very few ordinary carriages and wagons could be turned around on the spot, and they have witnessed the irresistible introduction of complete swiveling for the front axle with under-running of the front wheels. The old shortcoming survives only in the light American buggy, where it is comparatively harmless—unless the horse shies—and in cheap farm wagons. Daily observation of automobiles and motor trucks maneuvering in a street of ordinary width to get turned in the opposite direction, and holding up the traffic the while, never fails to suggest that the same old fault cannot be tolerated in automobiles forever. It is the mechanical penalty for propelling cars from the rear. Steering with all four wheels, as done now with a few motor trucks, is the most obvious remedy, when coupled with four-wheel propulsion, but is subject to objections when the wheels are against a curbstone or in ruts. In pleasure cars the rear wheels are also too close to the carriage body. As in many other cases, the final solution for automobiles is likely to come by way of the utility wagon, in whose construction fashion is less of a hindrance against innovation.

Tires

The cost of rubber tires is often interpreted as calling loudly for spring wheels or other substitutes. Not a little capital follows the call. But rubber is becoming more and more—and very rapidly—the staple crop of those immense tropical areas which civilization is opening up. It is already produced at 15 cents per pound f.o.b. at the planter's side track. Soon—when the investment charges shall have been liquidated—the world will get the full benefit of an enormous production. Cotton also will be much more widely cultivated, so as to make tire fabrics cheaper. On the whole, rubber and cotton have an excellent chance for holding their own against all substitutes. Supplying the means for cushioning road impact, deadening sound and improving traction, they will be harder to beat in ten years than now. But in the utilization of these materials the possibilities of the future are infinite. The whole wheel may be made of rubber and cotton by the aid of hydraulic presses, with only the bearings of steel and metal.

Overloading of tires! Overloading of springs! Overloading of chassis! Overspeeding of motor trucks and delivery wagons! These explanations, by which the blame for vehicle troubles is placed on the shoulders of owners, are too technical to satisfy. The more they are analyzed the more technical they become. The manufacturers who shall first be able to dispense with them, at least in the same degree that they were dispensed with before motors trebled the average vehicle speed, will begin to breathe the atmosphere of prosperity with new assurance. But it is true; tires, springs and chassis frequently do suffer from the combination of overload and high speed. There are limits to the endurance of materials. And the problems here involved are in part merely quantitative, in part educational. Owners and drivers must use *some* sense. But hail to the designers and inventors who manage to meet them halfway. A large part of the solution must lie in the proper mechanical organization of all the springy supports by which shocks are cushioned and in the further development of friction-resisted movements to govern the springs and add to their capacity.

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Strategic Moves of the War, June 22nd, 1916

By Our Military Expert

THE hardest part of attempting an analysis of the military developments of the great war is the self-consciousness of implied criticism of a number of technically thoroughly equipped men who have the promptest and most minute reports of operations at their command, the various general staffs; and the endeavor to fathom their movements and trace out the possibilities of their developments is equally difficult when it is remembered that only such bits of information as they and their censorship feel will convey no information to their opponents are given publicity. For these reasons, as well as for others, intent to prophesy is disclaimed; and if analysis of operations passed, gone by and admitted, is necessarily required to include probability of results, from deduction, by no means is it intended to convey any assumption of infallibility, while the request for indulgence in case of grave error in prognostication is made with due humility.

The Russian front from the Pripet to the Roumanian frontier naturally attracts the most attention to-day from observers. The whole world, marveling at the remarkable "comeback" of Russia, centers its attention upon this particular theater of war.

The past week has witnessed decided Russian gains on certain parts of the line, mainly toward the south, while at others the speedy and necessary concentration of opposing reserves has checked the progress of the great offensive.

The greatest Russian gains have been registered in the Bukovina section. Czernovitz, the capital of the province, has been evacuated by the Austrians, as expected; the capture of Sniatyn, west by north of Czernovitz, on the railway to Kolomea, practically forecast this result. The city itself is of little value beside constituting a base for a pivotal point at the Carpathians farther south, for it is not a junction of roads, controls no military sector strategically, and its taking constitutes more of a moral victory than anything else.

South of this city the Russian advance has pressed onward beyond the Sereth River. In the natural confusion which attends the virtual routing of an army lulled into a sense of false security, the giving of ground is to be expected, and so Czernovitz has fallen. Of far more military importance is the opening of the way to Kolomea by the acquired control of the single railway which leads westward from the place.

North of Sniatyn some slight gain has been made west of Zaleszczyki, where the Dniester has been crossed, while only negligible gains seem to have accrued to the attacking forces west of Buczacz. The Austrians, reported as having been strongly reinforced by German troops drawn from before Verdun as well as by men of their own ilk from the Italian front, are holding the Russians in the Tarnopol sector. This particular line is admirably suited to defense, being directly astride the railroad from Lemberg (Lwöw), over which the defending forces may easily be supplied with munitions and men and across which they are strongly intrenched.

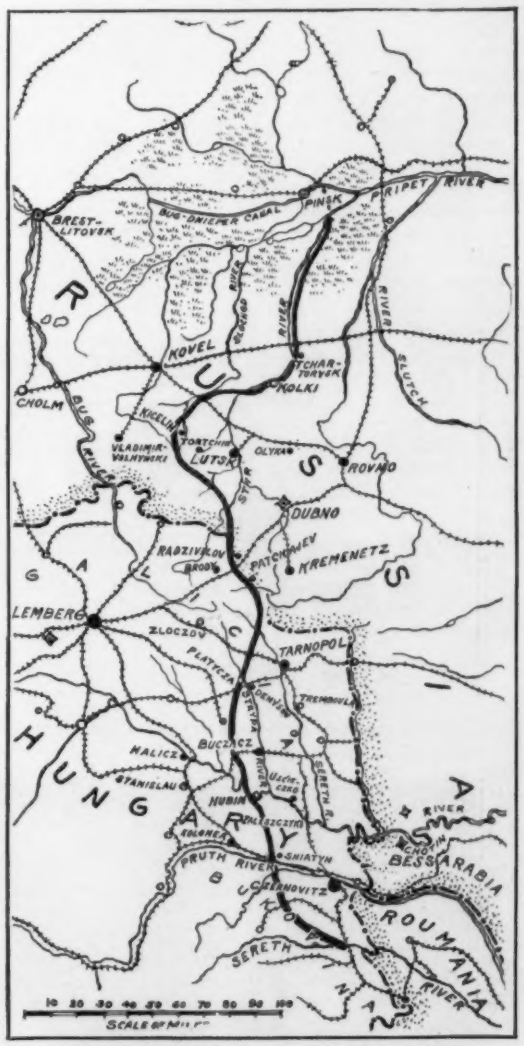
Farther toward the north, in the vicinity of Radzivilov, which is on the main railway from Dubno to Lemberg and is but a few miles from the Galician frontier, and Brody, in Galicia, Russia has made material gains, obviously steps toward the fortress town of Lemberg, a most important railway junction as well. It is reported that Teutonic reserves have taken strong positions between the present point of advance and this city in preparation to defend the approaches to the last.

To the northwest, however, important Russian gains have been made. Late reports indicate that the Czar's forces have passed the town of Kicelin, to the northwest, and are within twenty miles of Vladimir-Volhynski, the railhead which offers another avenue of approach to Kovel, the important railway junction thirty miles to the northeast. As the main advance against Kovel is being engineered from the direction of Lutsk, possession of Vladimir-Volhynski would create a powerful base for a secondary advance upon this point, one which would militate toward causing a comparatively bloodless evacuation of Kovel through the very threat to communications and the promise of extensive disaster to the Teutonic forces should the offensive prove a success.

Even though the point was stressed last week, it is not amiss to again invite the attention of the reader to the potential danger to Russia should her great offensive break down for any cause, through the long salient formed by the thrust in this sector.

A salient is notoriously the weakest strategic point in any line through the possibility of an opponent bringing to bear mighty pressure upon one or both sides; in case of a cave-in on either side the troops remaining toward the apex of the salient, beyond the break, are subject to probable isolation and ultimate capture, thereby causing a dangerous gap in the general line through which an opponent, in ample force, may pour troops to turn the general line. This particular danger spot acquires more significance when it is remembered that reports indicate the massing before it of Teutonic troops, not only Austrian divisions, but tried, hardy veterans of the German line who have gone through a veritable sea of flaming experience before the defenses of Verdun. Along the northern face of this salient, which practically conforms to the courses of the Styr and the Slochod Rivers, Russia has made practically no headway, topographical features and determined resistance having combined as deterrents.

Observers have learned to expect the most reasonable and pointed action by the German general staff, whether in the prosecution of a sustained offensive or in the dispositions for an active defense. Perhaps Russia will be able to muster a sufficiency of men and munitions to cause the evacuation of this line north of the salient and south of the Pripet—for it is a dangerous sector indeed to any troops included within its limits should an offensive against it gain sufficient ground to the front, a territory which it would be the height of absurdity to cling to under such circumstances—and secure the unquestioned control of the land, the northern flank of which is bound by the superlatively difficult line of the Pripet, with its attendant lakes, marshes and sloughs. Control of this ground would almost automatically force evacuation by the Germans of their line to the northward, even as far north as Riga, on the Baltic, and bring about a hasty abandonment of Russian territory and a general readjustment of lines.



The Russian battle front on June 21st, 1916

On the other hand, a successful cutting of the northern limb of the salient which thrusts toward Kovel, followed by a cataract of German divisions forming toward Lutsk, would inevitably imperil not only those Russian forces included within the lines of the salient, but the entire Russian line as well. A successful Teutonic counterthrust at this point would almost certainly carry the Kaiser to Rovno and beyond, secure control of this tremendously important junction and, in turn, compel a Russian readjustment of line south and north and do untold damage to the not too numerous railway lines of communication which the Russians were able to save from the disaster of the past September and October.

Activities have developed along the northern line, not far from Dvinsk. The reports to date fail to indicate truly whether they were instituted by Russian or Teuton; in either case it most probably makes little material difference, for it all seems to boil down to an attempt—by either side—to hold troops in place, containing operations. On the principle that an offensive against the northern line should result in stopping the Russian offensive farther south, it is not at all unlikely that Germany will deliver strong assaults in the section in question; but it may safely be taken for fact that such an offensive cannot be sustained, on account of dearth of reserves to follow it up properly. Germany cannot dare weaken her western lines in France and Flanders, for it is most evident that the great new British forces are but awaiting an opportunity to surge forward at the most propitious moment. The Austrian forces before Italy can probably be diminished, for the mountainous line of defense lends itself excellently to passive defense; but abandonment by the Austrians of their Italian offensive would constitute at least a moral victory for Italy—implied by failure of the Austrian offensive in the Trentino. The Balkan lines, it is said, have been almost stripped of German and Austrian troops, leaving Bulgaria the lone task of confronting General Sarrail's host of 600,000 men at Saloniki.

It seems incredible that the Entente can much longer allow Russia to sustain her offensive without complementary activity; while it is undoubtedly true that the cohesion of Teutonic direction of the war is far superior to that which obtains among the components of the Entente, in the possession of superior numbers the Allies, England, France, Italy and Belgium should be able to meet the advantage, for all fronts are occupied and backed by reserves, and there can be no complaint of present weather conditions. The opinion is therefore ventured that initiation of the general offensive by the Entente cannot and will not be long delayed.

Award of the John Scott Legacy Medal and Premium

THE city of Philadelphia, acting on the recommendation of the Franklin Institute, has awarded the John Scott Legacy Medal and Premium to Clement F. Street, of New York city, for the Street locomotive stoker. The increase in the size of locomotives during recent years has resulted in such large requirements in amount of fuel burned that in order to obtain a corresponding output from the engine, quantities of coal considerably beyond the capacity of ordinary firemen must be handled.

The Street mechanical locomotive stoker has been designed for keeping the fire in direct relation to all conditions of operation of the engine, and for securing the absolute maximum output of large engines. Over 600 of these stokers are in use at the present time and are understood to be giving satisfaction.

There has also been awarded the John Scott Legacy Medal and Premium to Hans Hanson, of Hartford, Conn., for his inventions embodied in John Underwood & Company's combined typewriting and calculating machine. The John Scott Legacy Medal and Premium has also been awarded to Frederick A. Hart, of New York city, for his inventions embodied in the same machine.

Using Adding Machines to Facilitate Work of Leveling Parties

THE precise leveling parties in charge of J. H. Peters and G. D. Cowie of the United States Coast and Goedetic Survey, operating in Indiana and Florida, respectively, are recording the readings of the level rods on adding machines as the work progresses. The machine is strapped on the top of a motor velocipede on which the party goes to and from the working ground. The leveling is done along railroads, and the car is moved forward with the observer as the work progresses.

The adding machines are now being used in the field for the first time in such work and the reports received at the Survey's office at Washington show that recording can be done more quickly and with less likelihood of errors than when the recorder used the old method of entering the observations in a record book. The backsights and foresights are recorded separately by the machine in parallel columns. The sums of these columns may be obtained by simply pulling a lever. The difference between these two sums is the difference in elevation between the starting and ending bench marks of the line. The machine is of the listing type, so that it gives a permanent record of the observations on the reel of paper. The saving of time and money in a single season will much more than pay for the cost of the machine, it is said.

Enlarging Pictures Without a Lens

A Radically New Departure in Photography

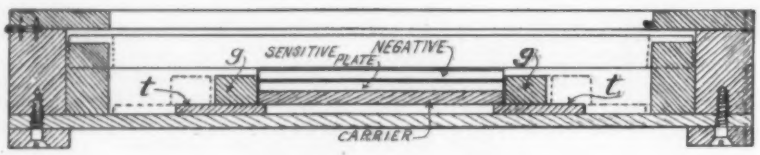
THE idea of enlarging photographs without the aid of a lens is not wholly new. By treating the film of a negative with certain solutions it is possible to cause it to become detached from its backing and to swell. In this way a certain degree of enlargement can be secured at the risk of injuring the film and without guarantee of freedom from distortion. It is, of course, also possible to make enlargements by using a pinhole in place of a lens, but the results obtainable by this method are necessarily very imperfect.

These are the ordinary expedients which may have suggested themselves to the reader on glancing at the title of this article. But that it should be possible to prepare an enlargement by direct contact printing, yet without in any way "stretching" the film, comes as a startling surprise, sounds, in fact, almost incredible.

Yet such is the process demonstrated by Dr. A. J. Lotka at a recent meeting of the American Physical Society and described in the current issue of its official organ, the *Physical Review*.

Briefly stated, the new method consists in exposing a sensitive plate behind the negative, in direct contact with it just as in the ordinary operation of copying a negative in a printing frame, but employing a narrow slit-source of light which illuminates only a narrow strip of the negative at a time. Moreover, as the exposure proceeds, the negative is moved past the slit so as to expose in turn every portion of the picture. At the same time the sensitive plate or film is also moved past the slit with a velocity equal to some constant multiple n of the speed of the negative. After development, fixing and washing in the usual way there is thus obtained a distorted positive copy of the original negative, the distortion not being, however, accidental and uncontrolled, but perfectly definite and in accordance with a fixed law: all lines parallel to the length of the slit are unchanged, while all lines at right angles to the slit are drawn out in the ratio of $n : 1$, as compared with the original. This distorted copy is then subjected to a second operation similar to that practised upon the original negative, except that now the motion is at right angles to the lines drawn out in the first operation. The product of this second step is a negative geometrically similar to the original, but on a scale n times that of the original, in lineal measure, or in other words, it is an enlargement of n^2 times the size of the original. Thus, for example, if $n = 2$, the product is an enlargement four times as large as the original.

It may appear at first sight as a disadvantage of the new process that it requires two successive operations. But upon reflection it will be seen that two such operations are necessary in any case if a *negative* copy of a negative is to be prepared. Once such an enlarged negative has been prepared any number of copies can then be made by any of the customary copying processes.

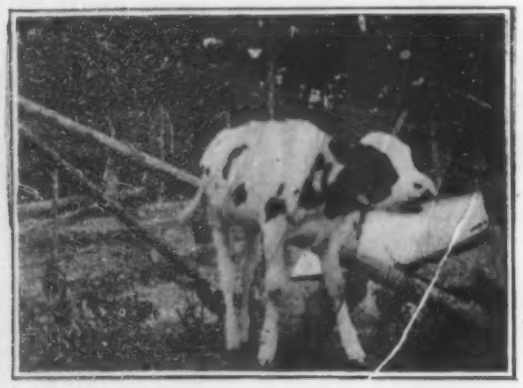


Cross-section of the enlarging apparatus

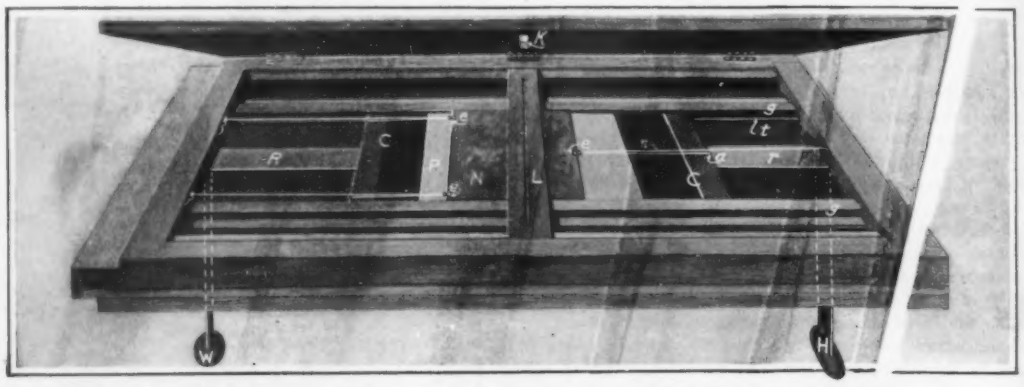
Our illustrations show an example of the work of the new process, and also an apparatus which can be used to carry out the process. This apparatus consists of a simple box containing a track t over which a carrier C is adapted to slide. Attached at a to the right hand end of the carrier C is a silk cord s which passes thence through an eye e and back to a pin p, where it is fastened to the end block of the box. Two further silk cords are somewhat similarly disposed at the left hand end of the apparatus. The eyes e may be attached (for example with gummed tape) to the glass back of the negative N, or, if a celluloid film be employed, to a separate glass plate to which the film is temporarily fastened with gummed tape.

It will be seen that the arrangement of the cords s and eyes e described above insures that, however the negative N be moved to the right or left, the carrier C, and with it the sensitive plate P, always moves in the same direction as the negative N, but with twice its speed. Over the negative is placed the narrow slit L, and during exposure the lid of the box, thrown open in the illustration to show the underlying structures, is of course closed. A slot K is so situated in the lid, that when the lid is closed, light from a suitable source placed vertically above the slit can gain access through it and through the negative to the sensitive plate beneath. The motion of the carrier and with it of the plate and negative is effected by drawing out the ribbon r by the aid of the handle H. At the farther end of the apparatus a similar ribbon R' may be provided, terminating in a weight W or other suitable tensioning device. The guides g,g for the sides of the plate P and negative N are adjustable laterally, so that they can accommodate plates of different sizes, and in particular, the original negative during the first stage of the process, and the distorted positive during the second stage. A corresponding change in the dimensions of the recess in the carrier, to receive the plate of the required size, can be made by means of a kit or in any other suitable manner. The process and apparatus is protected by a recent patent.

(Concluded on page 23)

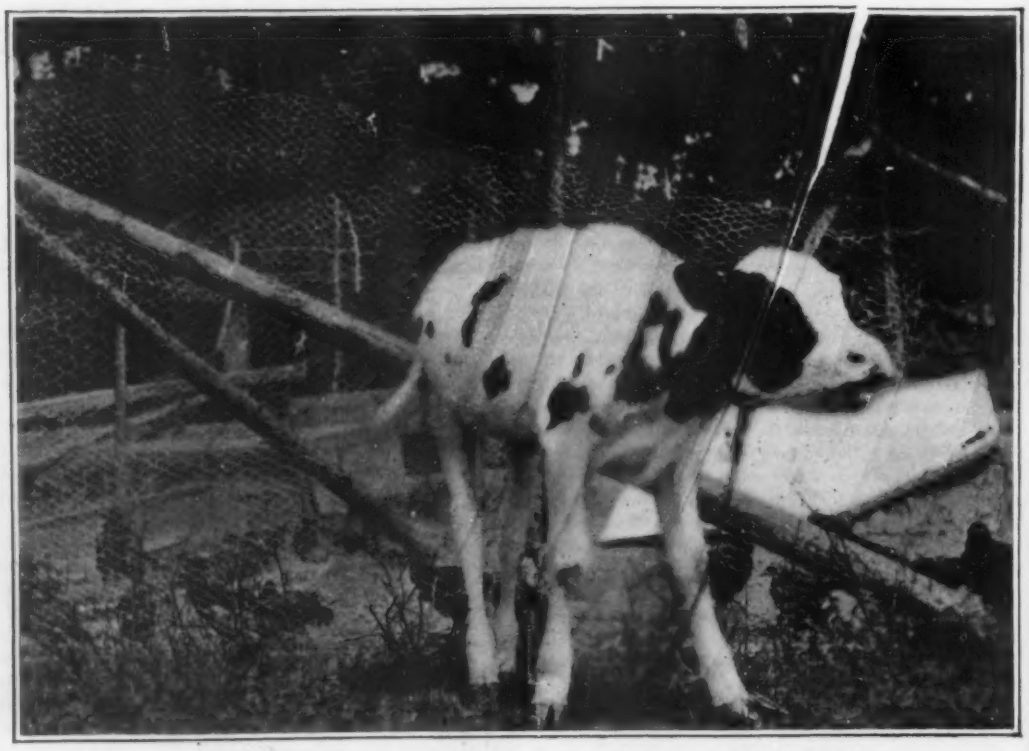


Print of the original negative

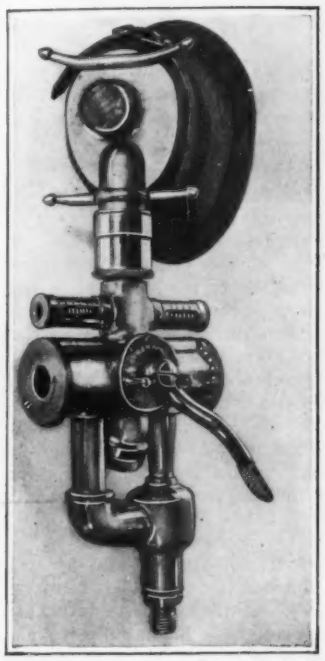


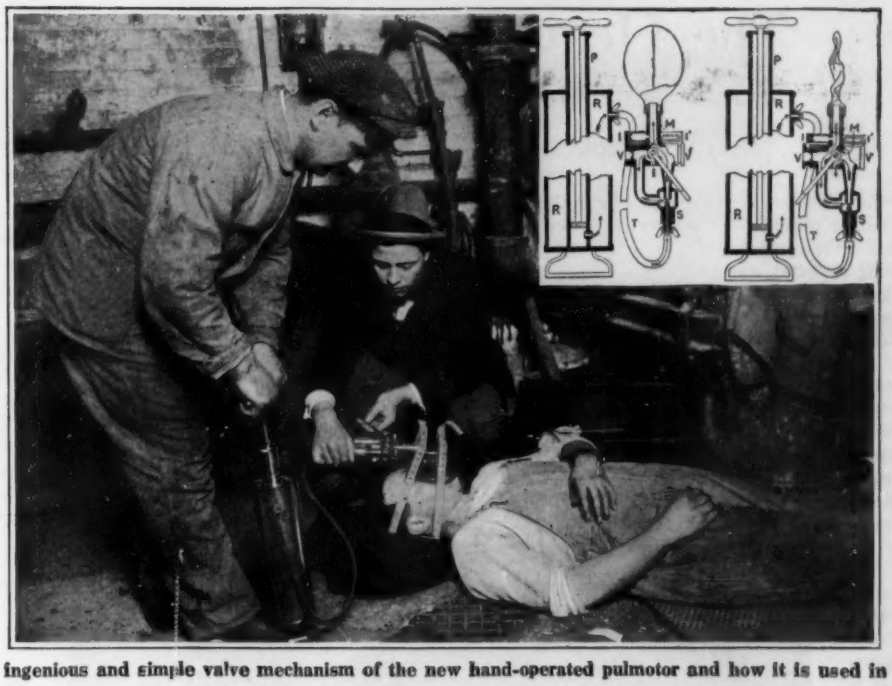
Apparatus with which enlargements are made by slit exposure of plates sliding in opposite directions

Print of the vertically distorted positive



Print of enlarged negative produced by lateral distortion of the distorted positive





Two views of the ingenious and simple valve mechanism of the new hand-operated pulmotor and how it is used in emergency cases

The end views show, respectively, the front and rear of the valve mechanism, which is operated by means of a lever to cause the inhalation and exhalation action according to the needs of the patient, and the mask. In the center appears a typical instance of resuscitation using the hand-operated apparatus. A diagrammatic presentation of the functioning of the apparatus is given in the insert drawing, the legend for which is as follows: *P*—Pump; *R*—Air Receiver; *T*— High Pressure Tube; *V*—Control Valve for regulating amount of Exhalation; *V'*—Control Valve for regulating amount of Inhalation; *I*—Indicator for measuring amount of Exhalation; *I'*—Indicator for measuring amount of Inhalation; *M*—Valve for Alternating Inhalation and Exhalation.

New Resuscitation Device on the Principle of Measured Pressures

UNTIL the present time practically all forms of hand-operated resuscitation devices have been designed to produce measured volumes of air, which necessarily depend upon the amount of pumping done. As a result, the real control has been centered in the man at the pump, whose only aim has usually been to pump as much air as possible. And, as often as not, when the patient began to breathe again the operation of the device has been working against the weak functioning of the lungs instead of aiding them toward their normal action.

Weighing but 12 pounds and especially suitable for emergency work, the new hand-operated pulmotor is based on the principle of measured pressures instead of measured volumes; and the treatment of the patient is centered in a pressure control valve which is operated entirely independently of the pump. The valve is of the combination type in that it not only applies but controls air pressures, and produces both inhalation and exhalation of the patient's lungs. The control is so positive that the operator may exert the exact pressures desired at every stage, which are determined by referring to two gages mounted on the valve mechanism.

The new pulmotor is not automatic, hence the treatment of a patient becomes a matter of care as contrasted to other methods where the mechanism

(*Concluded on page* 22)

Putting the Telephone Message in Writing with the Dictating Phonograph

WHILE the Edison telescribe is not, strictly speaking, a new invention, since it was described in the technical press some two years ago, it is only within the past few months that the numerous uses to which it can be applied in business have been more fully developed.

To those who have not read the descriptions of the telescribe which appeared when the instrument was first introduced, it may be briefly described as a device which links the ordinary telephone instrument with a slightly modified form of dictating machine; the connection, it is important to note here, is an acoustic one—no wiring or permanent mechanical union being necessary. The telescribe consists of a sensitive telephone for convenient desk use, with controlling buttons to operate a nearby dictating machine. With it the user can dictate cylinder records at conversational distance by using a horn; or, with but little delay, he can record all the words passing over the ordinary telephone by lifting the horn, which is hinged for the purpose, resting the telephone receiver in its place and listening through a small watch-case receiver attached to the telescribe.

Trained operator taking down on a wax phonograph cylinder the dictation received over the telephone

With the advent of the commercial telescribe we are told that the telephone offers at last a complete service. Heretofore it has been possible to handle a large volume of commercial transactions over the telephone, but there was ever present the danger of misunderstandings in direct proportion to the importance of the messages. In other words, while business transactions can be handled promptly and satisfactorily over the telephone, a written confirmation is usually lacking, giving

(*Concluded on page* 22)

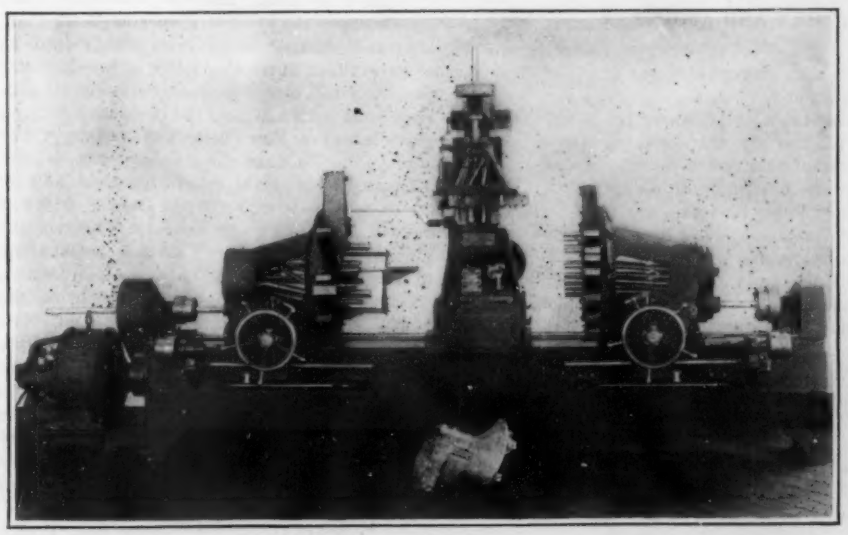
A Machine for Drilling Forty-Six Holes at One Operation

FOR drilling all the holes in an automobile transmission case at one setting, an American machine tool manufacturer has perfected the multiple spindle drilling machine which is shown in the accompanying illustrations. The machine is unique in that there are 46 holes in each transmission case and the drilling is done regardless of the fact that some of the holes are on an angle and vary in size from 3-16 to 1 11-16 inches. Each drill rotates at the same speed and each group of drills has independent feed.

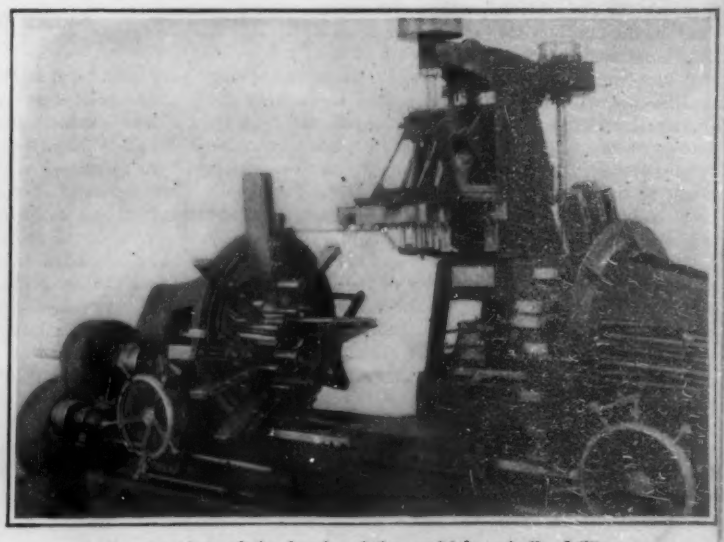
The multiple spindle drilling machine is operated by a 25-horse-power, 230-volt, 1,400 revolutions per minute motor of the commutating pole, direct current type, through a main driving shaft placed at the rear of the machine, connected to the horizontal heads by steel gears and cloth pinions, and connected to the vertical head by bevel gears. The motor operates equally well in either direction of rotation and can be reversed without changing the position of the brushes.

The bed of the drilling machine is supported on feet,

(*Concluded on page* 22)



A multiple spindle drilling machine that drills 46 holes in an automobile transmission case at one operation



A near view of the heads of the multiple spindle drilling machine

The Heavens in July, 1916

The Orbit of Wolf's Comet

By Prof. Henry Norris Russell, Ph.D.

WOLF'S Comet, whose discovery was described last month, turns out to be an interesting object. It was some little time before a reliable orbit could be calculated, for the comet's motion among the stars was unusually slow, and, under these circumstances, the small errors which are inevitable even in the best observations have an undue influence on the results of the computer.

A bulletin from the University of California, however, which has just appeared, gives orbital elements, calculated by Messrs. Crawford and Ulter, which represent a dozen or more observations—extending from April 24 (a photograph made by Prof. Barnard, three days before the discovery) to May 30—so precisely that there can be little doubt of their substantial accuracy.

According to these calculations the comet, at the time of discovery, was no less than 460,000,000 miles from the sun, and 380,000,000 from the earth. The latter distance exceeds that of any previous comet at the time of its discovery.

Though a few comets have been followed, on their return journey away from the sun into the depths of space, to greater distances—notably the first comet of 1889 which when last seen was nearly 800,000,000 miles from the sun—they are not often found on their approach, when no one knows where to look for them, until they have come much nearer and grown correspondingly brighter. Halley's Comet, in 1909, was first seen, even though it was known exactly where to look for it eight months before its perihelion passage, when it was still more than 300,000,000 miles from the sun, and Delavan's Comet, in 1912, was picked up, though unexpected, when nearly 400,000,000 miles from the sun; but the distance of this newly discovered comet exceeds either of these figures.

According to the computed orbit, Wolf's Comet will pass its perihelion on June 16th, 1917—nearly 16 months after the date of discovery—at a distance of 156,000,000 miles. The inclination of the orbit-plane to that of the earth is moderate, only 26 deg., and the nodes are so situated that the plane of the comet's orbit is nearly parallel with that of the earth's equator.

It is probable that the orbit is very nearly parabolic, as has been found to be the case for almost all of the brighter comets: but, so far, all that the observations indicate is that the period of revolution cannot be less than 50 years.

The annexed diagram shows the track of the comet and the orbit of the earth, with their positions at various times marked on the orbits and connected by lines.

It can at once be seen from this that, for the present, the comet will remain faint, its distance from the earth increasing, as we move to the farther side of the sun. Towards the end of October the earth will pass on the opposite side of the sun from the comet, and by the beginning of 1917 it will be visible in the morning sky. During the spring its distance will rapidly diminish, and throughout the summer it will be very favorably placed, being at its nearest to the sun, from 80,000,000 to 100,000,000 miles from the earth, nearly in opposition, and somewhat north of the celestial equator. At this time it should be at least 150 times as bright as at discovery, and not improbably much more, since comets of this type usually brighten up as they approach the sun far more than in simple proportion to the intensity of the light and heat which they receive. It may become visible to the naked eye, but is not likely to become conspicuous for it is now a very faint telescopic object, and, even if it increased a thousand fold, it would not be conspicuous to unaided vision.

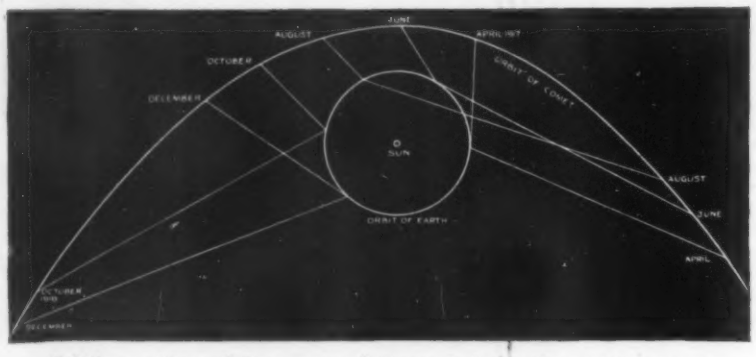
The comet will remain in sight in the evening heavens till after the close of 1917. After its disappearance in the sun's rays, it can probably be picked up again with powerful telescopes in the autumn of 1918, when it will be a little farther away, but not much fainter, than at the time of discovery. This long period of visibility makes it probable that its orbit may ultimately be very accurately determined.

The Heavens

As our map shows, the great white star Vega is nearly overhead at the hour of observation. East and northeast of it, but still very high in the sky, is Cygnus—a great cross of stars, with the longer arm extending along the Milky Way—and south of this is Aquila, with another bright star, Altair, flanked by a fainter one on each side. Below this, well down in the southeast, is Capricornus, marked by the brightest stars, α and β, close together—the upper one a fine naked-eye double. The fainter stars of the constellation, not shown on our map, form a triangle with curved sides, one of whose angles is at α, and another at δ.

Due south, in the most brilliant region of the Milky Way, is Sagittarius marked by the small inverted "Milk Dipper," and west of this comes Scorpio, whose whole length, down to the extremity of its recurving tail, is now to be seen if the air is clear.

West of the zenith is Hercules, marked by a keystone-shaped quadrilateral of stars, and below this the semicircle of the Northern Crown, and the brilliant Arcturus, with his lesser companions in Boötes, Ophiuchus and Serpens fill a large space in the southwest, with Libra below—marked by two conspicuous stars, α and β—and Virgo setting in the west. In the northwest we find the Great Bear, plunging head downwards with feet on the horizon, and tail high in the sky. The Little Bear and the Dragon are above the Pole, and Cassiopeia and Cepheus are lower down, in the northeast. The great square of Pegasus has just risen, as has Andromeda to the left of it, and forms the most conspicuous group in the eastern sky.



Relative positions of the comet and the earth during the next two years

At 11 o'clock: July 7.
At 10½ o'clock: July 14.
At 10 o'clock: July 22.

At 9 o'clock: Aug. 7.
At 8½ o'clock: Aug. 14.
At 8 o'clock: Aug. 22.

At 9½ o'clock: July 30.

NIGHT SKY: JULY AND AUGUST

The Planets

Mercury is a morning star until the 28th, when he passes behind the sun and becomes an evening star. At the beginning of July he is well visible, rising about 3:20 A.M., but by the middle of the month he is lost in the sunlight. Venus is in conjunction with the sun on the 3rd, and is invisible during the earlier part of the month; but later she appears as a morning star, and by the 31st she is conspicuous in the dawn, rising before 3 A.M., and ten times brighter than Sirius. Mars is an evening star in Leo and Virgo, setting at about 10 P.M. in the middle of the month. Though now about 160,000,000 miles from us, he nevertheless appears brighter than any of the neighboring stars, and is a conspicuous object.

Jupiter is a morning star in Aries, rising about 12:40 A.M. on the 1st, but before midnight on the 31st. He is in quadrature with the sun on the 27th, and is well observable in the morning sky.

Saturn is in conjunction with the sun on the 12th, and is practically invisible this month.

Uranus is in Capricornus, about 4 deg. northwest of δ Capricorni, and is visible almost all night, though not yet in opposition. He can just be seen by a keen eye, but is better observable with a field glass.

Neptune is in conjunction with the sun on the 25th, and is utterly invisible during the month.

The Moon is in her first quarter at 6:55 A.M. on the 8th; full at 11:40 P.M. on the 14th; in her last quarter at 6:33 P.M. on the 21st, and new at 9:15 P.M. on the 29th. She is nearest us on the 14th, and farthest off on the 1st and 27th.

The full moon on the 14th falls within three hours of perigee, and on this day owing to the perturbations of the motion produced by the sun, she is nearer us than at any other time during the year, her distance being 222,000 miles, which is only about 500 miles greater than the smallest possible value.

At this time the lunar tide-raising force is 25 per cent greater than the average, and exceptionally high tides may be anticipated.

As the Moon describes her circuit of the heavens, she comes into conjunction with Saturn on the 1st, Neptune on the 2nd, Mars on the 6th, Uranus on the 16th, Jupiter on the 22nd, Venus on the 27th, Saturn again on the 28th, Neptune on the 29th, and Mercury on the 30th. None of the visible conjunctions are close.

Eclipses

There is a large partial eclipse of the Moon on the evening of July 14th, visible at Washington, and throughout the United States—except that the moon does not rise for observers on the Pacific Coast until after the eclipse has begun. The Moon enters the penumbra of the earth's shadow at 9:18 P.M., Eastern Standard time; reaches the shadow proper at 10:19 P.M., and plunges deeper and deeper into its southern edge until, at 11:46 four fifths of her diameter is obscured: then she comes gradually out again, quitting the shadow at 1:12 A.M. and the penumbra at 2:14. These figures are for New York and vicinity. For points as far east as Portland the schedule of the eclipse is as much as an hour and a quarter slower. At Chicago it has its maximum at 10:55; at Denver, 9:46; at San Francisco, 8:36 (all local times). This eclipse, occurring at a very convenient hour for observation, will be of much interest to the amateur astronomer.

There is also an annual eclipse of the sun, on the 29th, invisible here, but visible in Australia, New Zealand and the East Indies. The line of central eclipse crosses the southern part of Australia, passing about 50 miles from the city of Adelaide, and within 150 miles of Melbourne. For points on this central line, the ring of uneclipsed sun, surrounding the Moon's disk, will be about 45 inches of all in width, and the annular phase will last some six minutes—during which about 95 per cent of the sun's light will be cut off.

Princeton University Observatory, June 19th, 1916.

Feeding a Hydro-Electric Plant with a Pump

THE problem of utilizing the original water of a lake for generating electric power, after the failure of the head of stored water in the basin, has recently been solved in an interesting way by the Eastern Oregon Light & Power Company, of Baker, Oregon.

Olive Lake, the scene of this unique undertaking, is located in the Blue Mountains, Grant County, Oregon, and forms the principal water storage reservoir for the operation of the company's 1,100 kw. hydro plant. Because of the loss by fire of one of the company's generating plants, the drain on this lake during 1915 was abnormal, and it became apparent in the fall that, unless reinforced in some manner, the stored supply would be exhausted before any water from melting snows became available in the spring of 1916.

Pump house on a log barge, which raised the head of water for operating a hydro-electric plant

The lake covers an area of about 200 acres with a depth of 50 feet, and apparently occupies the crater of an extinct volcano. It is fed by mountain streams which are gushing torrents for a few months in the spring, but diminish to small streams during the rest of the year. At the outlet of the lake the power company has constructed a dam which raises the original surface of the lake by 34 feet. This 34 feet, filled with the run-off snow water in the spring, comprises the normal storage water for the operation of the plant. When it became evident that this stored water would be exhausted, the plan of utilizing a portion of the original lake water was devised and put into operation.

A raft 40 feet square was constructed of logs and on this were placed two ten-inch centrifugal pumps capable of lifting 4,500 gallons of water per minute. Power for working the pumps was obtained by tapping a transmission line passing within a mile of the lake. Two pipe lines leading from the pumps to the intake of the main power pipe line were laid on pontoons and ice, and at the inlet of the main power pipe line a reservoir or tank about 20 feet square was constructed into which the water from the pumps was emptied and thence flowed into the power pipe line. Flexible joints in the pipe line leading from the pump station were obtained by means of rubber sleeves.

The amount of power for the short lift required to raise to the intake level the quantity of water needed averaged about 50 horse-power, and with this outlay of electric power the water produced at the generating plant its full capacity of approximately 1,500 horse-power.

According to the general manager of the company the results obtained were eminently satisfactory, and the method can be profitably employed to the extent of doubling the available water reserve of the plant.

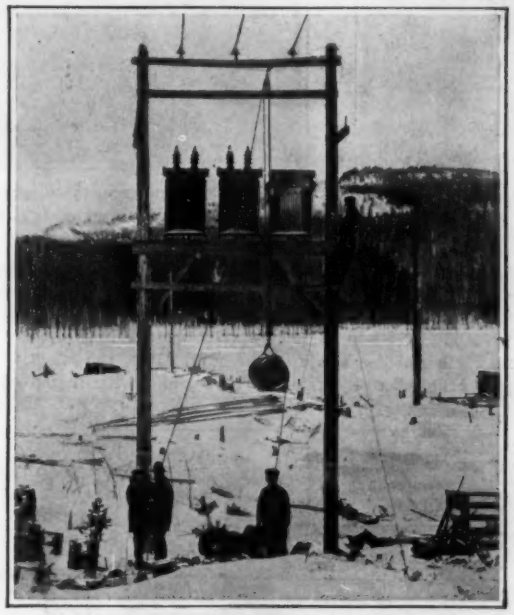
A Voyaging Lighthouse

THERE was a time when the shifting of a lighthouse site meant the scrapping of the tower. That was before the Government service was stirred to greater economy by the leaven of efficiency. The U. S. Bureau of Lighthouses has given recently an interesting example of money saving by transporting a fifth-order light from its old resting place to the tip of a newly-finished breakwater at Sheboygan, Wis.

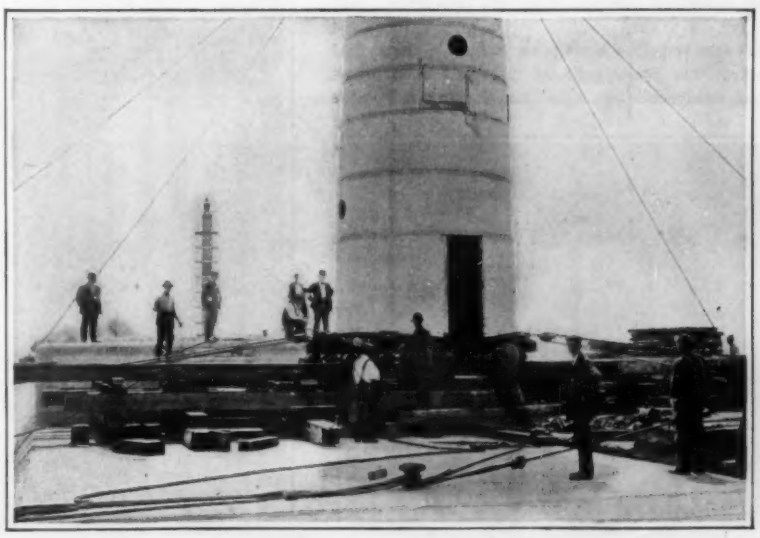
In the course of the improvement of the harbor, a new breakwater was installed. The lighthouse had previously rested upon what was known as the Old North Pier, and its light was not of sufficient strength to warn the mariner of the position of the dark outer end of the new breakwater. Therefore, it was a case of erecting a new light at the tip of the breakwater or transplanting the old tower to that place. The latter was decided upon and a concrete foundation built for the tower's reception. But the task of actually effecting the transfer remained and called for some engineering cunning.

Finally, the Government authorities determined to move the tower to a float, tow it to the end of the breakwater, and then slide it ashore and set it upon the foundation laid for it. The tower weighed 30 tons and, because of its shape, necessarily called for nice balancing as well as smoothness of movement during the shifting and towing operations. A scow 35 feet wide and 120 feet long was lashed alongside the old pier. Then the tower was raised from its foundation by means of jacks, and a heavy framework of timbers was built under the tower and across the scow. These were so arranged as to distribute the weight of the tower over the entire scow while the tower was being transferred from its old site to its bed on the scow.

With this trackway in place, wooden rollers were interposed between the lower courses of timbers and those upon which the tower directly rested. The jacks were then lowered so as to shift the weight of the lighthouse to this crude form of vehicle. By means of blocks and tackles and a windlass the tower was then moved from the pier onto the scow. Guy lines were attached to the upper portion of the tower by being passed through the ports or deadlights, and secured to the four corners of the barge. Thus ready for its voyage, the lighthouse was towed to the breakwater by a harbor tug. Arriving there, the scow was made fast, and the tower drawn ashore as it had been previously shifted from the pier to the scow. The preliminary preparations for the work had taken one day, another day was required for actually shifting the light from its original to its new position, and, finally, a third day was devoted to disposing of the gear used and fastening the tower upon its concrete foundation.



Installing transformers on the transmission line



Unloading the tower from the scow

Lighthouse tower on scow in transit

The Current Supplement

WHILE many people know that the human body is an electrical conductor hardly anyone realizes that it must rather be regarded as an electrical system. This is a fact of the greatest interest both to the physician and to the electrician, which is treated of in *The Human Body as an Electrical System* in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2113, for July 1, 1916. The Filipino child has nearly as many playthings as the children of other lands, and, although not very elaborate they are ingenious and successful for their purpose. *Filipino Toys* tells about them, and gives pictures of a large number. *The Rusting of Iron* discusses a subject of which but little is definitely known, and also considers some preventatives. *Electroplating with Cobalt* gives some of the results of an extended series of experiments in the application of this metal for the protection of various other metals that are subject to oxidation. These results should interest many manufacturers. *The Columbia River Highway* tells about a new stretch of modern road in the State of Oregon of great scenic attractions in laying out which artistic methods were adopted. *Modern Air* tells us many things about the relation of air to health, and will be found of interest to everyone. Pictures on the screen are so universally employed, both for entertainment and educational purposes, that the article on *The Projecting Lantern*, telling many things about its construction and operation, will be appreciated. It is illustrated by diagrams. *Dynamical Stability of Aeroplanes*, *The Application of Scientific Methods to the Improvement of the Sugar Beet* and *Power Situation in Germany and Austria During the War* are other articles of value in this issue.

A New Type of Portable Telephone for the Forest Rangers

A PORTABLE telephone, made of aluminum and weighing two and one half pounds, the invention of a Forest Service officer, R. B. Adams, of Missoula, Montana, will be part of the regular equipment of patrolmen of the National Forests the coming field season. This instrument is regarded as a great improvement over the set formerly used, which weighed ten pounds.

It is reported that a field man equipped with this telephone, a few yards of light emergency wire, and a short piece of heavy wire to make the ground connection, can cut in anywhere along the more than 20,000 miles of Forest Service telephone lines and get in touch with the headquarters of the supervisor or district ranger. To talk, one end of the emergency wire is thrown over the telephone line, the two ends are connected to the portable instrument, and the instrument is connected to the portable ground wire the end of which must be thrust into the damp earth or in water. Contact with the line wire is made possible by removal of the insulation from a few inches of the emergency wire.

The Adams instrument does not ring the bell of the receiving telephone, but instead causes a screeching sound from a small megaphone-shaped apparatus descriptively known as a "howler." This instrument is installed at the ranger station and is said to give effective notice that some one is on the wire. If the field man needs to talk with some one elsewhere on the line, the ranger station instrument can be used to ring up the person at any time he is wanted, when the conversation can be readily carried on.

Forest officers state that these portable telephones are especially valuable in reporting fires and other emergencies with the least possible delay, and also in sending instructions to field men and keeping the district rangers informed as to the progress of work going on in the field, thus supplementing the regular telephone sets installed at lookout points, ranger stations, and at convenient intervals along Forest Service roads and trails.

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

An Automobile Which Carries its Own Road

WITH the object of checking skidding, an inventor has devised a broad traction belt that slips over the rear tire of an automobile and is sufficiently large to roll over a steel bearing attached to the running board. Balata gum belting affords a good grip upon the pavement, even under very trying conditions. It has been tested in rainy weather on steep grades in San Francisco, and though the car was driven at a reckless speed, halted suddenly and turned sharply, it showed no tendency to skid. The device was equally successful in deep sand, and was given a thorough try-out in the neighborhood of Tucson, Arizona, to demonstrate that it "carries its good road as it goes."

The belt is a little wider than the tread and protects the latter from wear to such an extent that it is claimed that the life of the tire is doubled by its use. Also the tough belting is a protection against glass, nails or other objects that cause punctures. The material is proof against water, acid and alkali. It does not interfere with the speed or operation of the car, and is readily adjusted to any machine.

Arrangement of belt for preventing the skidding of automobiles

Fiber box and removable partitions devised for the safe shipment of eggs by parcel post

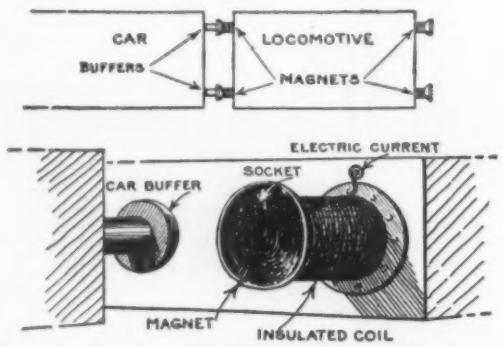
Switching Cars by Magnetic Coupling

ONE of the most fruitful fields for railroad accidents is the terminal yard, and the largest number of casualties are incident to the making and breaking up of trains, especially freight trains, where the trainmen take great risks in coupling and uncoupling, poling, switching, etc. This is not to be wondered at, because there is commonly a spirit of haste in all of these operations. There is the ceaseless struggle to save fractions of minutes in order that trains may be dealt with according to schedules. Familiarity with danger breeds proverbial contempt, and then follow accidents of varying gravity.

At Berne, Switzerland, the railroad authorities in the big train yard have developed a rather novel type of locomotive for switching service, and, in consequence, loss of life and injuries have been materially reduced. The locomotive is a storage battery affair capable of doing a long day's work without need of recharging, but the distinctive feature is the way in which coupling is done away with in making up or switching trains. The locomotive takes hold of the adjacent car by means of magnetic grips, and the pull so exerted is strong enough to deal with a very considerable load.

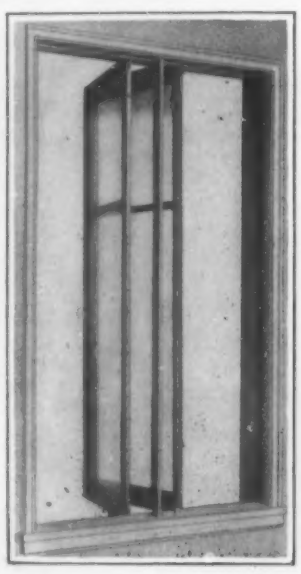
At the two ends of the locomotive and directly opposite where the buffers project from a neighboring car, the tractor also has two buffers, but of quite a different sort from those on the car. These buffers are iron cores surrounded by induction coils, and can be energized by the engineer at will. The outer ends of these magnets have cup-like discs into which the car buffers with their convex heads enter. This allows for considerable play, and really makes of the contiguous buffers a ball-and-socket joint — the union being maintained by magnetism.

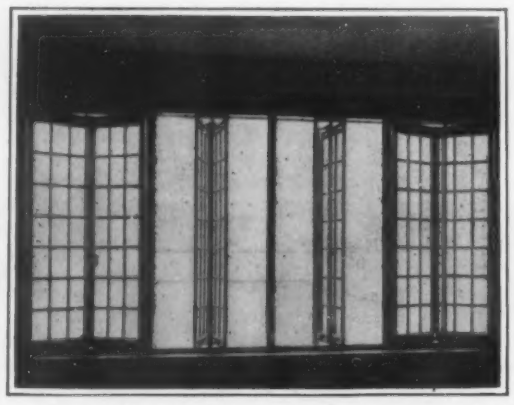
When a car is to be shifted or a train moved about the yard, the motorman pushes the locomotive up against the two neighboring buffers and throws in his switch just before contact is made. Instantly, when the four buffers meet, they grip, and no one is exposed in perfecting this coupling. It takes 220 watts to energize each magnet in service, and, therefore, double this to deal with a one-end load. The tractive force that can thus be exerted amounts to a draw-bar pull of 7,480 pounds, and when the load is a light one, one magnet alone need be energized—the pull then amounting to 3,740 pounds. If there is not perfect contact between the magnets and the heads of the car buffers, the effective pull falls, of course; but, even so, and with a gap of two-tenths of an inch, each magnet is effective for a tractive force of 1,980 pounds.



Magnetic coupling and how it is applied on a Swiss freight yard locomotive

It is not hard to realize the advantages that a yard locomotive of this description possesses. The quickness with which it can grip or release a car makes it an ideal instrument in the rapid shifting and switching incident to making up or breaking up trains. The magnetic hold is so strong that the motorman can work with certainty and speed up his operations considerably beyond that possible with an engine, and but one man is required to control the locomotive and its functions. The State railroad has been using these locomotives at Berne for some time, and they have proved thoroughly efficient and economical, besides cutting down yard accidents.





Three views of a new type of window, showing its operation and installation

Parcel Post Egg Carrier

ANNOUNCEMENT has just been made of a parcel post container which has the unqualified approval of post office experts. The committee on experiment, research and design of the Post Office Department, in its report, said: "It is superior in every way to any other containers for this purpose that have been submitted to this committee for examination."

The container is built specially to contain eggs, but the fiber of which it is made is said to be a non-conductor of heat and cold, thus making the container valuable for the shipment of perishable goods. To prevent the breakage of eggs, an inner arrangement of fiber partitions is provided which absorbs all shocks from the side. A cotton padding at the ends provides the small protection necessary for the ends of the eggs.

The box is indestructible, the inventor claims, and easily supports the weight of a man on top or sides. It is made of the same fiber as used in the construction of car wheels, and thus combines the required strength and lightness, making the postage on the average shipment of a dozen eggs but two or three cents, including the return of the box.

The inventor has also patented a reversible tag which simplifies the sending of the box between the farmer and the consumer. Stamping and addressing the tag on both sides is said to insure the return of the box to the original sender, the post office authorities having promised to make a ruling against withholding it when thus stamped for return.

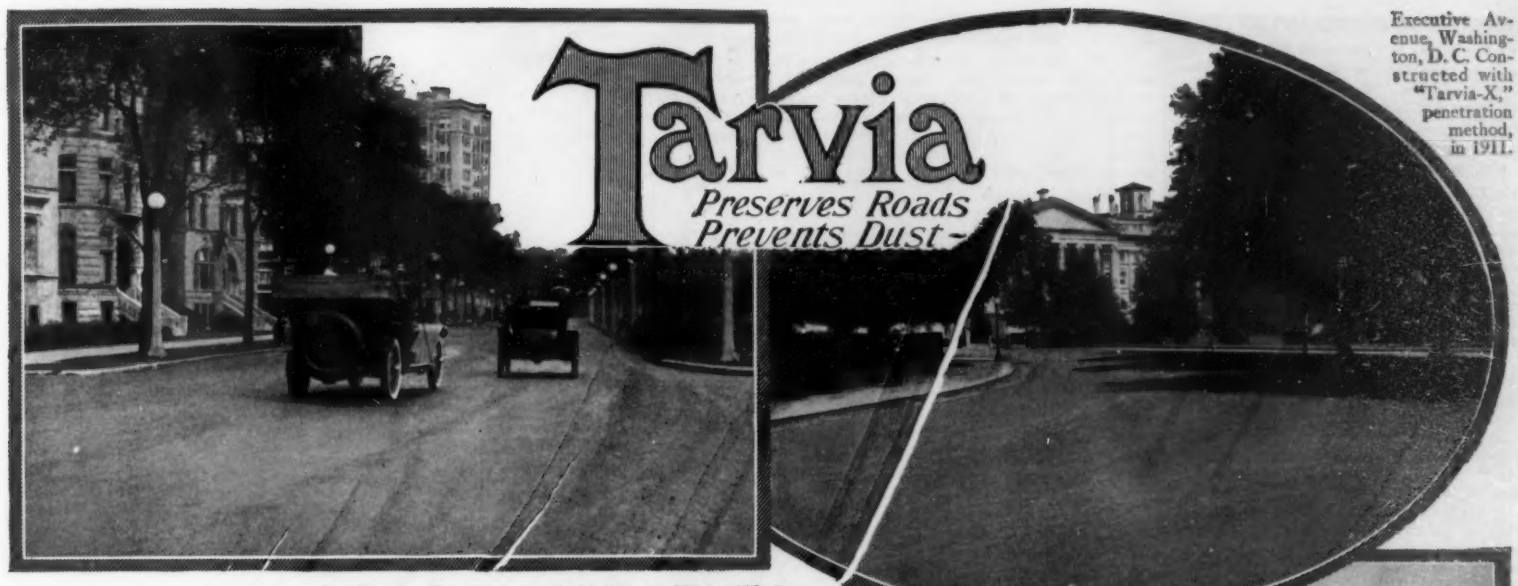
It is planned to lease boxes at 50 cents a year, and to have the box distributed by fourth-class postmasters, for the most part. A bag is also provided where it is desired to combine several boxes in one shipment.

A Window that is Different from Other Windows

TO the average lay mind, windows are merely means of providing light and ventilation; but to the architect and builder they present a serious problem. Since the advent of large buildings, inventive minds have devised numerous windows in the effort to provide a type which would give maximum light and ventilation, and adequate protection against fire, weather and dust. The difficulty of cleaning windows in large buildings has also been a serious problem, owing to the danger to which the window cleaner has been exposed. The upkeep expense of windows has always been a large item, and it has become necessary to devise a simple construction which would give lasting service without constant repair.

Window difficulties are met in a most ingenious manner by a window which embodies an entirely new idea. It is neither double-hung, casement, pivot nor balance, but is claimed to combine all the excellent features of these types in a simple and novel operating principle. The new window is the invention of R. B. Browne, of Maspeth, N. Y., who has given considerable study to the win-

(Concluded on page 29)



Executive Avenue, Washington, D. C. Constructed with "Tarvia-X," penetration method, in 1911.

Lake Shore Drive, Chicago, Ill. Constructed with "Tarvia-X" in 1909. Surfaced with "Tarvia-A" in 1915.

Riverside Drive, New York City. Treated with "Tarvia-B."

Dustless, Durable Tarvia Roads at Low Cost—

TARVIA roads are to be found all over the country—hundreds of miles of them!

Those who have motored, driven or walked over these roads know the comfort of their smooth, resilient surface and their freedom from dust and mud.

Many of the parkways of New York, Chicago, Philadelphia, Boston, Cleveland, Detroit, St. Louis have beautiful Tarvia roads.

State roads in many States, branching from the great cities, have been treated or built with Tarvia. Here you'll find no dust and no mud.

Countless small cities and towns have Tarvia roads because the taxpayers have come to realize their durability and appreciate *the low cost of building and upkeep.*

Perhaps it never occurred to you before that many of the easy-traction roads which seemed to give speed to your car, ease to your vehicle and comfort to your horses, were treated or built with Tarvia.

Many of the most famous roadways in America are Tarvia roads.

For instance, Riverside Drive in New York, north from 157th Street, one of the parade avenues of the Nation, is treated with Tarvia.

The Lake Shore Drive of Chicago is another. You may know its national fame for it is one of Chicago's famous roadways.

Executive Avenue in front of the White House in Washington is another Tarvia road.

Even 'way up North, at Chicoutimi, on the Saguenay where the thermometer drops to 40 degrees below, you will find Tarvia roads. Tarvia is as unbreakable by Canadian cold as by boulevard traction.

Tarvia roads represent the maximum of durability at the minimum of cost. They are an asset to any community because they reduce taxes, increase property values, decrease haulage charges and end the dust nuisance.

Three grades of Tarvia are made, to suit varying road conditions:

"Tarvia-X" is a dense, viscid coal tar preparation, which is applied hot. It has great binding power. It encloses the stone in a tough matrix and makes the road dustless and automobile-proof. It is used for constructing new roads.

"Tarvia-A," applied hot, is for protecting macadam and concrete roads from heavy traffic and making them dustless and proof against water and attrition.

"Tarvia-B" is applied cold. It enters the road crust and cements it together, preserving the road surface and preventing dust.

Illustrated booklets on request. Address nearest office.

Tarvia X
The Barrett Company

Fac-simile of label appearing on "Tarvia-X" barrels.

Special Service Department

In order to bring the facts before taxpayers as well as road authorities, The Barrett Company has organized a Special Service Department, which keeps up to the minute on all road problems. If you will write to nearest office regarding road conditions or problems in your vicinity, the matter will have the prompt attention of experienced engineers. This service is free for the asking. If you want *better roads* and *lower taxes*, this Department can greatly assist you.

The Barrett Company

New York Chicago Philadelphia Boston Cleveland St. Louis Cincinnati Pittsburgh
Detroit Birmingham Kansas City Minneapolis Nashville Salt Lake City Seattle Peoria
THE PATERSON MANUFACTURING COMPANY, Limited: Montreal Toronto Winnipeg Vancouver St. John, N. B. Halifax, N. S. Sydney, N. S.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel

BRACELET.—B. R. JOLLY, care of the Jolly Wynne Jewelry Co., 128 Fayetteville St., Raleigh, N. C. This invention provides a construction whereby the links may be regarded as a bracelet or as a necklace. It also provides a construction of a link which incloses a spring in such a manner that a flat serpentine cut spring may be used or a substantially flat coil spring may be used.

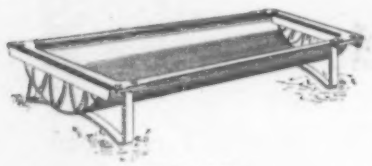
Electrical Devices

ELECTRIC FURNACE PERMITTING THE EXTRACTION IN A STATE OF ZINC FROM ITS ORES.—E. F. CÔTE and P. R. PIERRON, both of 6 Rue Grotée, Lyon, France. This invention relates to an electric furnace permitting the direct extraction in a state of purity of zinc from its ores. The metal, having been separated from the ore in rough state in an electric furnace, preferably an arc and resistance furnace, is refined as it is being produced, while it is still at a temperature near the point of volatilization, in such manner as to obtain directly pure zinc, with a minimum expense of calories, the minimum of labor and without losses.

Of Interest to Farmers

COMBINED HOG BREEDING, LOADING, RINGING AND MARKING CRATE.—G. L. BRUNER. Address A. E. Garten, Attorney, Loretto, Neb. The invention relates more particularly to a crate into and through which hogs may be driven, a vertically and horizontally adjustable stanchion being provided for this purpose, which, in its lowest position within the crate may be moved horizontally to accommodate hogs of various sizes, and which, when elevated, permits the crate to be used as a loading frame in connection with wagons, railway cars, and the like.

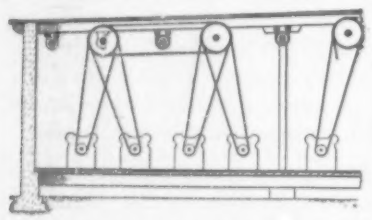
HOG TROUGH.—M. H. SCHUETZ, 419 3rd St., West Yankton, S. D. This invention is an improvement in hog troughs, and provides a trough of one-piece construction, and a suitable



HOG TROUGH

support for the trough, that will prevent overturning, and wherein all danger of damage to the trough from the forming of ice is eliminated, and wherein the expansion and contraction from temperature changes cannot injure the trough.

INTERCHANGEABLE DRIVING MECHANISM FOR COTTON MACHINERY.—J. F. CANNON, Concord, N. C. Mr. Cannon's invention relates generally to the driving mechanism for cotton machinery and more particularly to driv-



INTERCHANGEABLE DRIVING MECHANISM FOR COTTON MACHINERY

ing mechanism and driving connections for spinning frames and including both mechanically and electrically operative elements arranged in such relation to one another and to the spinning frames that the driving connections to the spinning frames may be shifted from the mechanical to the electrical elements and vice versa.

Of General Interest

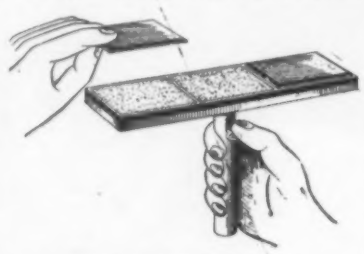
SURGICAL CASE.—C. M. SORENSEN, 177 E. 87th St., New York, N. Y. The invention relates to cases for carrying instruments, bandages, adhesive tape, absorbent cotton, bottles and jars for liquids and pastes, etc., required by chiropodists, dentists and others particularly when called away from their offices, and provides a case fully equipped with all the requirements in a readily accessible manner, which also carries a sterilizing outfit for the instruments ready for use before, during, or after use of the instruments.

BURGLAR ALARM.—J. L. MCMAHON, 128 E. 60th St., New York, N. Y. The inventor provides a burglar alarm more especially designed for sounding a whistle on the opening of a door, window or like device by a burglar or other unauthorized person, and arranged to enable the occupant of the room to render the burglar alarm inactive on the owner entering the room.

HORSESHOE.—E. L. MILLER, R. F. D., Glen Gardner, N. J. In this horseshoe the shoe and toe calk thereof are formed in a manner to facilitate the placing and removal of the calk; the improved shoe is applied to the hoof with a minimum of cutting of the hoof; and the calk is held firmly and securely in position.

GATE HINGE.—J. W. DAVIS, R. R. No. 2, West Terre Haute, Ind. In the present invention one of the principal objects of the inventor is the provision of an improved gate hinge formed preferably of pipe sections and fittings in which strength and paucity of parts are combined with simplicity and beauty of design.

ICE-CREAM SANDWICH MOLD.—V. O. HOPKINS, P. O. Box, Drawer D, Winston-Salem, N. C. This invention provides a mold especially



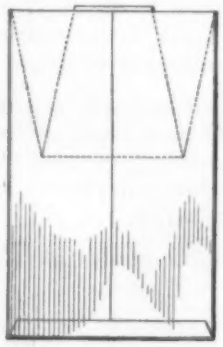
ICE-CREAM SANDWICH MOLD

adapted for making sandwiches from ice-cream frozen sherbet, etc., in which two, three or more sandwiches may be formed and ejected from the mold at one operation. It provides means for quickly taking the mold apart in order to clean the same. It also provides mechanism in the handle of the mold for automatically ejecting the sandwiches when formed.

REINFORCED CONCRETE CULVERT.—J. H. DARROW, Billings, Mont. In this invention the object is the provision of a simple inexpensive, and efficient culvert, formed of upper and lower concrete sections, the joints of which are staggered and the reinforcement of which sections is utilized as means for detachably securing the upper and lower sections.

SIGN LETTER.—M. CREIGHTON and A. W. DIXON, Rensselaer Falls, N. Y. This improvement provides a form or construction of sign letters or characters, the same being made preferably of sheet material such as metal adapted to be stamped up into form and having an ornamental border along either its upper or lower edge together with a novel form of end piece making a finish for the completed sign corresponding to said border or borders.

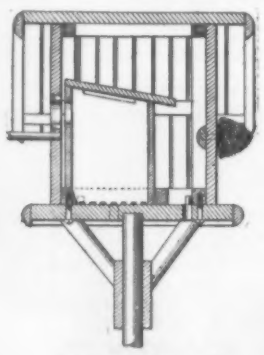
ENVELOPE.—L. A. LEE, National Soldiers' Home, Tenn. The inventor provides an elongated closure adapted to be folded intermediate to its ends and inserted into the opening in the



ENVELOPE

envelope with the extremity of closure projecting slightly beyond said opening whereby it may be grasped and the closure withdrawn when it is desired to remove the contents of said envelope. He provides the closure with a reinforcing element in order to facilitate the insertion of the closure into the envelope opening and also prevent the contents of the envelope from forcing said closure outwardly.

BIRD HOUSE.—E. H. REIBER, West Webster, New York, N. Y. Realizing that the rapid decrease in the number of native song birds is due principally to the destruction of natural nesting sites and the severe weather conditions



BIRD CAGE

that have prevented propagation, the inventor, after many years of study of the birds of the house-nesting kinds and of experimentation with bird houses, has arrived in the present invention at results which include all the necessary conditions for the nesting of birds, for the successful hatching of their young, and for the health of the young birds whereby they may leave the nests in condition to reach perfect maturity. The house is constructed of red cedar and sassafras.

Hardware and Tools

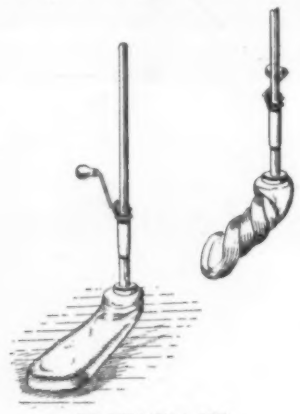
PIPE WRENCH.—J. A. ROBERTS, The Anchorage, Marietta, Ohio. The wrench is easily adjusted to and removed from the pipe, which takes a firm grip and will not slip, and which

PIPE WRENCH

is strongly made and durable in service. The invention provides a replaceable die which serves as the biting jaw and which die provides eight edges, all of which can be worn out before a new die is required.

Household Utilities

MOP.—J. L. WILLIAMS, P. O. Box 64, Du Pont, Wash. This invention is of the self-wringer type in which the mop cloth may be wrung without wetting the hands. It is devoid



SELF-WRINGER MOP

of frames or other projecting parts which might scar or mark the furniture or woodwork while the mop is in operation. The mop cloth is constructed so as to hold a piece of scouring soap while the mop is in use. The cloth may be readily wrung through means operated by a crank, and should the crank be removed the cloth may still be conveniently and quickly wrung without wetting the hands.

FLUSH TANK.—MIGUEL FERRER, San Juan, Porto Rico. The improvement provides a structure whereby the flow of fluid to the tank proper is controlled in such a way that when the tank is discharging the same is cut off from the main supply, and when the flow is cut off from the tank the same is connected to the main supply.

WINDOW CURTAIN.—JOSEPHINE D. ARCHARD, 42 Bayley Ave., Yonkers, N. Y. More especially this invention relates to curtaining the lower part of a window frame of the vertically movable sash type, and provides means for effectually curtaining a window which means also permit ventilation of a room in degrees under the control of the occupant of the room according to whether the curtain is set for absolute privacy, entire interior exposure or various stages therebetween.

FAUCET ATTACHMENT.—F. G. HODELL, Cleveland Galvanizing Works, Cleveland, Ohio. Mr. Hodell's invention relates to the delivery of water under pressure at desired points, as by a hose or the like, either in a stream or as a spray, and the main object thereof is to provide means in connection with the water conduit for impregnating the water with desired ingredients previous to its discharge at the end of said conduit.

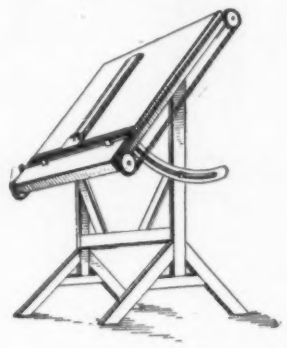
Machines and Mechanical Devices

FEEDING MECHANISM FOR CIGARETTE MACHINES.—H. J. AITON. Address Day, Davies and Hunt, 321 High Holborn, London, W. C., England. The improvements are in machines of the kind where cut tobacco is fed from a hopper by a rotating carding-drum, which spreads it over a wide transversely arranged traveling feed-band or the like, which delivers it onto a narrow longitudinally arranged traveling tape or the like, forming the bottom of a tobacco channel, whence, the rod of tobacco is passed in a straight course onto a paper strip to be formed and cut into cigarettes.

PAPER FEEDING MACHINE.—A. BROADMEYER. Address The W. O. Hickok Mfg. Co., Harrisburg, Pa. The invention relates more particularly to automatic machines for use in connection with ruling machines, the primary object thereof being to provide a feeding machine operable in timed relation from a ruling machine to feed sheets continuously, or at proper intervals thereto, which will be highly effective for this purpose.

PAPER SUPPORTING TABLE FOR PAPER FEEDING MACHINES.—A. BROADMEYER. Address The W. O. Hickok Mfg. Co., Harrisburg, Pa. The invention provides a feed table detachable from its support for removal when its supply of paper has become exhausted which, with its said support, carries coöperating means whereby it may be quickly and easily placed upon such support in definite, exact relation to the other parts of the machine, and also provides a feed table having paper guide members preventing lateral movement of the stack thereon, and capable of ready adjustment to accomodate paper of various sizes.

DRAWING RULER.—W. S. SAMPSON, 3502 Grove St., Oakland, Cal. The ruler is for use of architects, draftsmen and the like, and is mounted on a drawing board or table so that



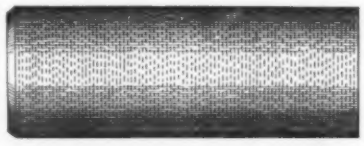
DRAWING RULER

it may be moved from end to end of the table, while retaining its transverse position with respect to the table, the ruler being provided with a guide extending longitudinally thereof, for guiding a carriage with respect to the ruler, and a second ruler is connected with the carriage to permit the said ruler to be held at varying angles with respect to the first named ruler.

Musical Devices

MUSIC LEAF TURNER.—J. BOYER, care of L. C. Young, Bend, Ore. The invention has particular reference to a device adapted to be attached to a musical instrument and operated without the necessity of the player using his hands. It provides a device wherein the sheet turning arms are successively actuated through the medium of a flexible connection, by a member operated by a knee of the player.

SOUND RECORD.—LAURA COCHEMS HAHN, care of Mrs. Clark P. Bassett, Sturgeon Bay, Wis. By taking advantage of the fact that beats distinguishable to the ear when a given



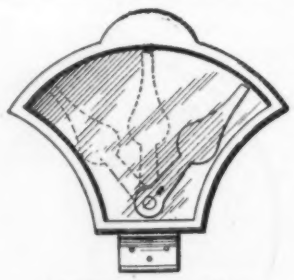
SOUND RECORD

tone interval is sounded, must have a certain frequency in order to produce in the completed circle an equal temperament, it is possible to time the circle of a keyed instrument by progressively sounding and justifying the tone intervals, and the invention provides a device by means of which these tone intervals are sounded, or may be reproduced in the proper order of progression through the circle, to serve as an invariable guide to the instrument tuner.

Pertaining to Vehicles

VEHICLE WHEEL.—R. C. WEAVER, Tarrytown, N. Y. This invention provides means for compensating for the usual service wear on wheels of this character; provides means for contracting and expanding the wheel felly to accommodate the wheel tire; provides means for preventing twisting of spokes in the wheel structure; and provides means for preventing rattling of the spokes and securing relative uniformity in the movement thereon.

DIRECTION INDICATOR.—F. E. JUSTUS, 1118 Arizona St., El Paso, Tex. One of the principal objects of this invention is the provision of an improved electrically operated direction indicator, in the nature of an arm

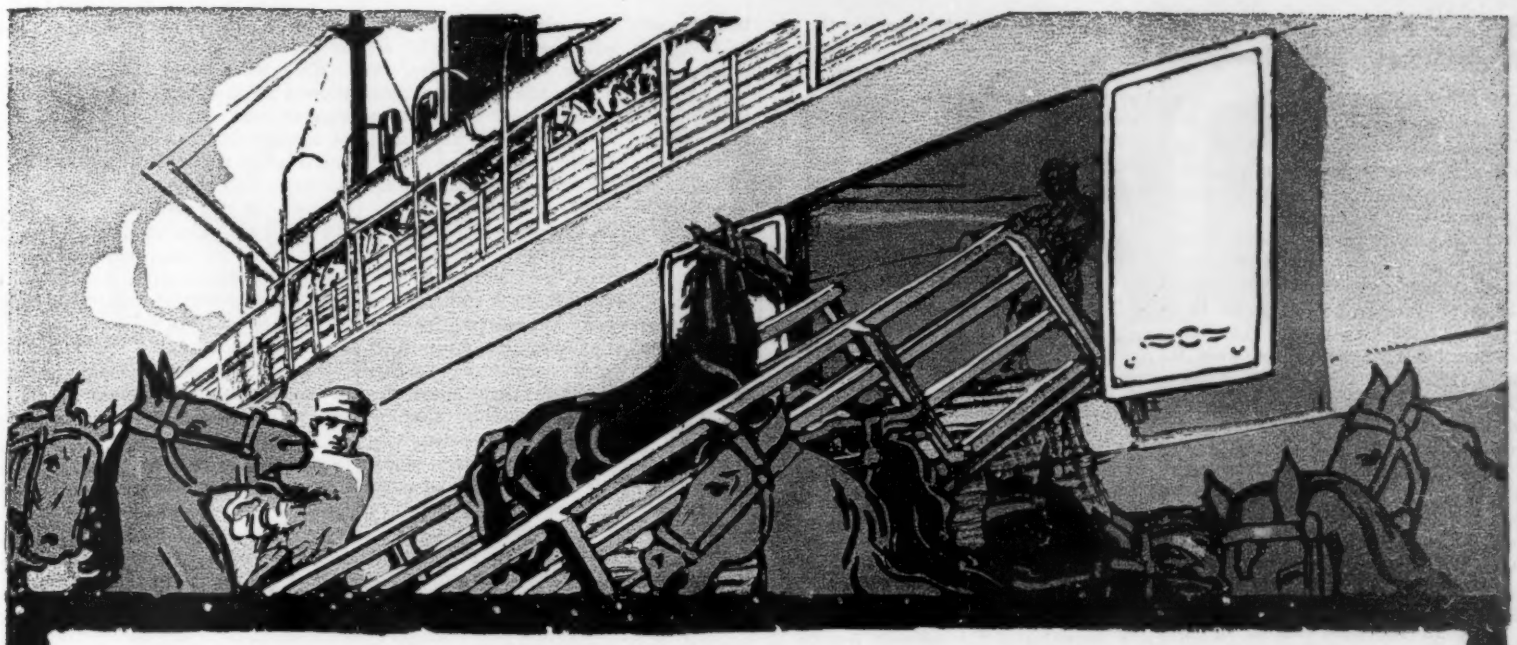


DIRECTION INDICATOR

pivotally mounted in a casing and operated by an electro-magnetically controlled lever whereby to be moved into positions for indicating the directions in which vehicle to which the device is applied is about to move.

DUMP WAGON.—H. MEKLING, 1044 Hall Place, Bronx, New York, N. Y. This improvement has reference to dump wagons and relates more particularly to the dumping end thereof. An object is to provide a simple, strong and inexpensive dumping wagon which will not allow any liquid matter present in the wagon to leak out.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.



War's Waste of Horses Sends Prices Soaring

Do you know that this country's exports of horses jumped 1700% in a year? This amazing fact is disclosed in an official report of the United States Government. Exports of horses for the fiscal year ending June 30th, 1915, were $64,000,000 as compared to $3,500,000 for the year ending June 30th, 1914.

There is no need for us to interpret the meaning of these figures to the business men who depend upon horses for delivery or transportation service. Obviously it will be years before the soaring prices of horses can return to a normal level, if indeed, they ever do.

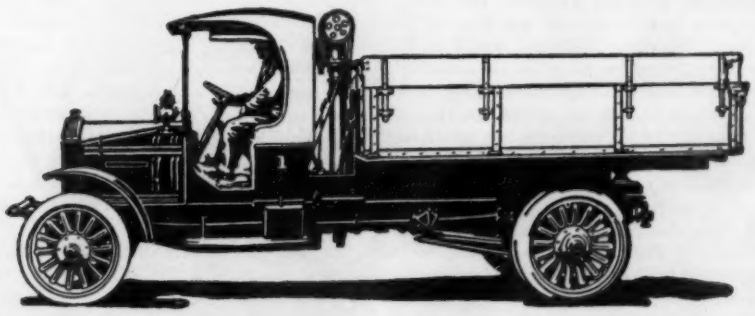
Under the circumstances we believe that you would be interested in reading our booklet, "Pierce-Arrow Motor Trucks." It makes no extravagant claims for motor trucks in general or the Pierce-Arrow in particular. But it does tell in an interesting way, and largely by means of actual photographs, exactly what Pierce-Arrow Motor Trucks are doing in many different lines of business. We shall be glad to send you a copy.

PIERCE
PIONEER WORM DRIVE

The Worm-Gear

All Pierce-Arrow Trucks are equipped with the worm-gear drive, which is a positive guarantee of effective service under the most difficult conditions.

THE PIERCE-ARROW MOTOR CAR COMPANY, BUFFALO, N. Y.



Putting the Telephone Message in Writing With the Dictating Phonograph

(*Concluded from page* 15)

rise to serious disputes at times. It is for this reason that the most important application of the telescribe is in conjunction with the recording of important telephone messages.

While the uses to which the device can be applied are manifold and diversified, perhaps the more important are suggested in the installation of the telescribe in a large manufacturing plant in the East. Here there has been established what is known as the central telescribe station, consisting of one of these devices installed on the desk of the head of the transcribing department. It is now possible for any one in the office, plant, or even at a distant point, to ask for the central telescribe station and, after securing the connection, dictate a letter to be typed by one of the numerous operators for immediate delivery in the organization itself or to be mailed out. Again, if through any cause an important official of the company finds it impossible to reach the office and is confronted with the necessity of dictating a number of letters, he may do so by getting in touch with the central telescribe station. And in the matter of telephoned instructions to employees the telescribe is of utmost value, for after the recorded message is transcribed the recipient of the orders is protected by a written confirmation which avoids all misunderstanding and subsequent disputes.

Salesmen's dictation should be telephoned from the outside, where the orders are, for this avoids trouble and congestion in the office, while the representative of the firm saves time and dictates a better letter when a matter is fresh in his mind. Dictation in this way may be made in the presence of the customer, who is interested to have the letter properly worded. Telegrams and notes are likewise expedited in an office by prompt typing and dispatch from the telescribe station.

Telephone messages received during the absence of the party for whom they are intended can be recorded by the telescribe and delivered in the form of a written message. This means that the person calling need never be disappointed, for the message can always be given to the telescribe.

In the plant where the central telescribe station has been installed the tendency in every branch of the business is to put everything into writing. If a foreman in the works desires to bring a certain matter to the attention of an executive, he does so by calling up the central telescribe station and dictates the memorandum or report. In this manner the facts are perhaps more accurate than they would be in a verbal report, not to mention the fact that the report can be more readily referred to at any time. Then, again, should an executive, while going through the plant, have a certain suggestion brought to his attention, he can go to the nearest telephone, call up the telescribe station, and dictate the facts that he wishes to refer to later. Meanwhile the employee, standing near him during the time the dictation is proceeding, is in a position to vouch for the correctness of the statements.

The telescribe is not an automatic machine, for it requires the services of a person of ordinary intelligence to operate it. When the telephone connection is made and the request is received to use the telescribe, the operator in charge of the device starts the dictaphone by pressing a button on the former. Should the dictator desire to stop at any time, he mentions the fact, whereupon the operator presses another button, which prevents the further rotation of the wax cylinder. At the word to start again, the first button is depressed, and so on. The necessity of an operator for the telescribe is not to be considered a disadvantage; quite to the contrary, it greatly enhances the flexibility of the equipment. Should the party at the other end of the wire desire to have the dictation repeated to him, this is done by the operator, who manipulates the dictating machine in the usual manner. At any point desired the operator can stop, and if any corrections or alterations are necessary a note can be made of them. Were the operation of the telescribe automatic, it would not be possible to make corrections and changes so readily.

A Machine for Drilling Forty-Six Holes at One Operation

(*Concluded from page* 15)

providing ample space for cleaning under the machine and preventing the floor from becoming watersoaked if drilling compound is used. All reciprocating parts are inclosed in cast guards, effectually protecting the operator from injury. Various spindle speeds are obtained through gear reductions incased in oil-tight boxes on the heads. The spindles are equipped with ball thrust bearings and universal ball joints. An improved type of arm allows a center distance between holes equal to the diameter of the spindle. Spindles may be adjusted for different lengths of drills by operating but one screw at the outer end of the arm. The horizontal heads have standard belt-driven feed with automatic control and quick traverse by hand wheel. Vertical head and cluster box slides are automatically controlled by left-hand head through trip rod and bell crank which operate a jaw clutch on the reversing gears in the gear box. These gears control the shaft operating the pinion and racks attached to the vertical head and slide.

In operation, the left-hand head is brought forward, automatically engaging the feed of the vertical head and cluster box slide, which travel the required distance and automatically return to neutral position. The feed for right and left hand heads is now engaged by levers. At the same time a spindle on the box jig drills the hole. Feed is automatically tripped by stops and the heads return to neutral position, completing the operation.

New Resuscitation Device Based on the Principle of Measured Pressures

(*Concluded from page* 15)

functions automatically and sometimes irrespective of the requirements of the patient. Still, its operation is so simple that anyone can employ it successfully after once possessing a superficial knowledge of the valve. The latter is worked by an operator who takes his place at the head of the patient, while the pump is worked by an assistant. The pump is so constructed that pumped air can not return into the pump; instead, it is stored in a tank surrounding the pump until the valve lever releases it.

Despite its multitudinous functions, the valve mechanism is surprisingly simple. The two accompanying drawings graphically represent the various parts and their arrangement at inhalation and at exhalation. For inhalation the control lever is swung to the right, which closes all outlets which would draw off air from the lungs. The arrows clearly show the action of the valve at this stage, and it will be noted that the pressure of the air delivered to the lungs may be regulated by adjusting the control valve at the right, which allows the excess pressure to escape to the open air until the desired pressure is indicated on the gage at the right. The center chamber which, in the drawing, appears to have no outlet except that leading to the distributing valve, is in reality open to the outside air through a suitable filter; hence in the inhalation operation air is not only supplied by the air receiver or storage tank of the pump, but a certain amount is also drawn through the filter by the action of the injector. For exhalation, the lever is swung to the left, closing the direct valve passage to the lungs and permitting the pump to draw off the air in the lungs. The second drawing clearly shows the action of the apparatus by means of arrows. By turning the milled rim of the valve at the left, the negative pressure of exhalation may be modified to any extent desired, this being accomplished by admitting air through this side valve. It will be noted in the diagram that exhalation, or the drawing out of the air from the lungs, is accomplished by the action of the injector, and that the air is released into the outside air through what constituted the inlet filter in the inhalation process. In both drawings a rubber bag is shown connected to illustrate the action of the lungs.

In actual operation, it is the work of but a few moments to apply the mask to the face of a patient, and strap it in place. The valve mechanism attaches directly to the mask, so that it is over the patient's head. The operator takes his place at the valve, while an assistant works the pump in order to store up air in the tank; it is not necessary to pump continuously, for once the necessary pressure is obtained it can be maintained by an occasional stroke. Meanwhile the operator moves the lever of the valve back and forth to obtain uniform exhalation and inhalation, timing these with his own breathing. By means of the indicator gages, the operator knows exactly what pressures are being exerted on the lungs at all times, and the great importance of this feature lies in the fact that patients of different ages and cases of different kinds should be given entirely different lung pressures. The instant that the patient attempts to resume normal breathing, the gages flutter, no matter how faint may be the action of the lungs. The operator, instead of timing inhalation and exhalation by his own breathing, now times the operation of the valve to those of the patient and thus assists him to full return of voluntary respiration. An extraordinary feature in this connection is that the patient can resume normal breathing while the mask is on, which is a new accomplishment for hand-operated devices. To be more explicit, despite the action of the valve mechanism, the patient at all times has free access to the outside air should normal breathing be resumed. Further, if the operator prefers, the mechanical exhalation can be dispensed with.

From a mechanical standpoint, the hand-operated pulmotor is remarkably ingenious, more so because of its simplicity. No automatic or ball valves are used, so that failure to operate at a crucial moment is practically impossible. The wear is infinitesimal; weather conditions cannot affect the operation of the valve parts, and it is claimed that no adjustments are ever required.

Passing of the Tented City

(*Concluded from page* 10)

he desired to know, even if it did not delight the souls of his bomb-dropping aviators.

If the reader looks back over the many photographs he has seen of the events of the war in Europe, he will find that none of them show the conventional American type of tented camp, save perhaps at bases, or prisons, a long way from the scenes of activity.

To do away with the tent in this country would be nearly impossible, barring perhaps operations on the Atlantic seaboard, where there would be a chance to billet men for the night, or for any longer stay. Even at that, imagine the fierce indignation of the American small town denizen or of the American farmer, if ordered peremptorily to provide sleeping accommodations and meals for so many tired and dirty, and not too well mannered soldiers. The mild mannered and tractible European peasant is missing in this country. Every man's house is his castle, and it is doubly so in the case of soldiers, because our folk do not like soldiers.

For general operations we will have to change the color of those tents so long as we have to stick with them. Dun-hued tents may be well enough for partial concealment from those on the same level, and for the greater ease of the eyes of the soldiers inhabiting them, but the question of their proper color is now to be solved only by the opinions of aviators gazing at them from overhead.

With the color once found, then the present method of arranging the tents in regular rows, surveyed by the eagle eyes of regimental commanders, and lacking only sewage and electric lights to be regular cities, will have to be abandoned. Regardless of the color adopted, light and shade remain with us, and the low rays of a sinking sun, casting strong light and shadow over the regular rows of the most invisibly colored tents, would tell the tale as quickly as huge signs posted for the benefit of the flyer.

Not only will some confused combination of colors have to be adopted, but some irregular arrangement of units will have to be followed in camps. If a brigade can be held within 400 acres if arranged neatly as delights the heart of the soldier, then the modern camp will have to use up 600 to 1,000 acres, and be scattered gracefully, carelessly and artistically over the ground instead of in long straight rows, and squares.

Because, a camp so scattered out and so broken up in arrangement, will not attract the eye from its regular arrangement, and if discovered, it will not invite bombardment like closely packed tents, and if bombarded the results will be far less from the scattered nature of the units of the target.

So in future we may expect to find the neat brown camp of the American regular, metamorphosed into an "un-neat" irregular, scattered horror of tents painted in colors like unto the dream of a drunken cubist, but the ensemble failing to catch the eagle eye of the watchful enemy aviator high above.

The Field for New Achievements in the Motor Vehicle Industry

(*Continued from page* 12)

Decline of the Speed Mania

Popular interest is graduating from luxury cars to utility vehicles, from speed for speed's sake to the ideas of service. Many who have thought in gasps on motoring subjects are beginning to reason in sequence. There are car owners so unprejudiced that they hire a hansom when they wish to go promenading in park or streets, as they find that cars, as they are made, are uncongenial to the real promenading spirit, which is that of receptive and leisurely contemplation. The byways are now sought by tourists. On the whole, there is a little revolt against gadding and aimless hustling by motor power; a feeling that cars could get nearer the imponderable but important amenities in life. The issue is not clear, but it is shaping itself, and a few clues to possible developments are cropping out as needs and demands in the utility vehicle field.

A Motor "Spring Wagon"

Certain types of motor vehicles for which there should be constant use are not manufactured. There is nothing corresponding to the "spring wagon" which was plain people's family carriage as well as their quarter-ton truck. A $200 motor wagon for similar uses, slow and of small power but capable of incessant service, cannot be beyond the resources which produce motorcycles at a lower price and promise agricultural tractors at $250. Looking further, one finds that on the whole the slow grind in transportation work is still left to the animals, as if the time-saving and wage-saving due to speed were still needed to make motors economical and preferable. Capacious vehicles for municipal work, such as collection of garbage and ashes, which are required to jog along slowly with numerous stops and interruptions, are not made, although some huge machines at high cost are seen here and there in the big cities, covering the trunk-line routes in this class of work. Motor ploughs for the ordinary small farmer are in their mechanical infancy. Excavating contractors depend on steam derricks and horses. The parallel with pleasure car mechanism

(*Continued on page* 26)

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(14118) A correspondent asks further statement upon Query 14058, regarding the point-blank range of a modern high-powered rifle, since a bullet begins to fall as soon as it leaves the muzzle of the gun. A. The definition of "point-blank range" given in the note referred to, was copied verbatim from the Century Dictionary, under "point blank." The term does not seem to be used as a scientific term, but as the equivalent of short or close range. Nor would it seem to be used of a "bull's-eye," but only of a shot which would not miss the target, at close range, in the sense given in the dictionary. In one tenth of a second the projectile which has a velocity of 2,500 feet, will go 250 feet, and fall less than 2 inches from the level of the muzzle. That would hardly spoil a bull's-eye for such a gun. The Encyclopedia Britannica, Vol. 23, page 335d, says: "Strictly speaking, there is no such thing as 'point-blank range,' the bullet commencing to drop immediately it leaves the muzzle of the rifle. The path or trajectory of the bullet is, therefore, always a downward curve. The higher the velocity the flatter the curve. The 'fixed sight' or so-called 'point-blank' range, is usually taken at such range, generally 100 yards, with black powder, and with such elevation as to render the amount of drop of the bullet or curve of the path, practically immaterial for sporting purposes, say 4½ inches. At shorter distances this curve would take the bullet so much above the fixed-sight aim, and must be allowed for where necessary. With the high-velocity small bore rifle the fixed-sight range can be increased to 200 yards for the sporting rifle; and for military purposes in the field to 500 yards, and with pointed bullets even more." The brevity of the former answer left the matter obscure. This will place before our readers the exact statement. The practical adjustment is to fix the sights so that the bullet shall cross the horizontal line from the muzzle at the distance given above. For greater distances the adjustable sights must be raised.

(14119) D. C. C. asks: Can you give me a simple way of calculating the variation of the compass? What I wish to know is what method is used by surveyors in running lines from old surveys—that is, how do they find out how much to allow for magnetic declination when there is no old line known? A. There is no way to determine what the variation of the compass needle was at a date in the past excepting from records. The county records, or the State records, should give the variation in the past. The average annual variation can be obtained very closely from variations ten years or more apart. Failing to obtain data from the State records, you may obtain them from the United States Coast and Geodetic Survey, Washington, D. C. The records of the survey are very full. The survey can give the annual change of variation in your neighborhood, and probably the actual variation for a long time in the past, since your region has been settled a very long time.

(14120) C. R. T. asks: Have had a world of trouble keeping water from seeping through cement in the basement of my house. The soil for the past year, due to heavy snows a year ago this winter and heavy rains all spring and summer, is abnormally wet. Basement has always been dry as a bone until last summer. Had it recemented and patched in places since, but am not able to check it completely. It has occurred to me that you might be able to suggest some preparation or something to mix with cement and sand that would make it hard enough and dense enough to be impervious to water. It seems to me that if you can make a cistern water-tight within and without you ought to be able to make a cellar bottom the same way. I have succeeded in checking the seepage to a large extent, but there are places where about two pails a week come in, and the floor is wet and damp in that place right where we use it the most. A. Waterproofing a cellar from the inside is rather difficult. Probably one of the best home remedies is to apply several coats of silicate of soda thinned with warm water. Before the application of each coat the surface should be washed off with clear warm water, each coat being allowed to dry for from 24 to 36 hours before the application of the next coat. The silicate of soda forms a chemical compound with the lime in the concrete and makes an impervious layer integral with the wall. Waterproofing compounds applied to the inside face of the wall withstand the pressure of the water from without only by the bond of the compound to the wall, and are, therefore, liable to be forced away from the wall when the ground water is present in sufficient quantities to form a hydraulic head. Cellars should have a course of waterproofing at or near the outside of the wall, so that the waterproofing will be forced against and not away from the wall by the water pressure.

(14121) J. W. B. writes: In your issue of January 1st, 1916, Notes and Queries, does the sun ever set on the United States and its possessions. It was shown that the sunrise band covered 170° 19′ 18″.8, leaving only 40′ 41″.2 of the circumference of the globe. Sorry to have neglected for two and one half months to mention that the diameter of the sun may be considered, for it is 32′ 4″ in diameter, subtracted from 40′ 41″.2 leaves 18′ 37″.2; from sunset on the western part of the Philippines to its rise on the eastern point of Portó Rico, or in time 1 minute 12.2 seconds, approximately nine sixteenths of the sun's diameter. A. Our calculations were for the center of the sun, but the almanac times of sunset and sunrise are for the last ray of light at sunset and the first ray at sunrise. In other words, the upper edge of the sun's disk is taken and not the center for the local times of sunrise and sunset. Allowing these the result becomes, as our correspondent states, above. We may, therefore, say that there is but 1 minute and 12.2 seconds in any day when the sun would not be shining on American soil if the earth were spherical. But the mountain tops of Porto Rico catch the first rays of the rising sun before the last rays leave the mountain tops of the Philippines. This, however, is a point which does not allow of mathematical analysis.

(14122) G. H. M. asks: 1. Is 186,330 feet per second the most accurate number for the velocity of light? How was it determined? 2. An article in the *Popular Science Monthly* gives the velocity of electromagnetic waves as 300,000,000 meters per second. Is this correct and how was it determined? 3. Would the velocity of an electric current through a non-resisting conductor be the same as that of the electromagnetic waves? A. 1. The velocity of light is 186,330 miles a second, not feet per second as you write it. The latest and best determination of this velocity was by Professor Newcomb. The method of measuring the velocity is described very fully in the SCIENTIFIC AMERICAN SUPPLEMENT, No. 557, which may be had from the Wilson Company, as per attached slip. The several processes which have been used in finding the velocity of light since 1675, when it was first measured, are given in Carhart's "College Physics," price $2.25 net, postpaid $2.45. 2. The velocity of electric or electromagnetic waves in space is the same as that of light, since light is an electromagnetic phonomenon. 3. The velocity of an electric current through an unresisting medium is the same as that of light. The wireless signals sent from Arlington to Paris and San Francisco were but a minute fraction of a second on their passage. The description of these most interesting experiments is given in SUPPLEMENT 2051, which we send for ten cents.

(14123) A. W. O. asks: I have a clipping from SUPPLEMENT No. 22,042, treating on cadmiun in testing storage batteries by E. C. Handy. At close of article he says sulphate can be removed, if treated by a chemist, at a minimum expenditure of energy. Have you any articles in the SCIENTIFIC AMERICAN or SCIENTIFIC AMERICAN SUPPLEMENT giving this method of treatment, if not where can I get information along this line? Have you any more articles on cadmium in relation to battery testing? A. We have no articles upon the testing of storage batteries other than the one you mention nor have we published any late information upon the removing of the sulphate from plates. You will find all these matters in Lyndon's "Storage Battery Engineering," which we send for $4.00. This book is the authority upon its subject.

(14124) P. J. B. asks: Please tell me definitely what is meant by the term "phase," such as "three-phase" and "poly-phase" as applied to electric currents. Does it not apply to alternating currents only? And is it not quite distinct from the "cycle"? A. The words phase and cycle pertain to alternating currents only. A cycle is the time occupied by one series of changes in the electromotive force. "Sixty cycles" means that the e. m. f. passes through its changes sixty times each second. The word phase also refers to time. When two alternating currents are in phase they reach their zero, maximum and minimum values at the same time. Their e. m. f's keep step with each other. A three-phase curtions of the e. m. f. pass their zeros 120 deg. apart, or is out of phase 120 deg. The fluctuations of the e. m. f. pass their zero 120 deg. apart. In a two-phase current the e. m. f's pass their zeros 90 deg. apart. The word poly-phase refers to all currents which have two or more phases.

(14125) H. E. F. asks: I have heard it said, that a dog *trotting* across a steel bridge (providing there is no other object moving on the bridge at the time) is liable to wreck the bridge. Is this so? I should be obliged if you will answer in the Questions and Answers column of SCIENTIFIC AMERICAN of which I am a constant reader. I understand that it is the regular movement or action of the dog's *trot* that starts the bridge swinging, and finally wrecks it. A. Synchronized vibrations will shatter almost anything. It has been demonstrated that, if the correct pitch is known, a tone from a violin will shatter a glass goblet. The reason for this is that the frequency of the sound waves of the particular tone is the same as the frequency of the vibrations in the goblet; in other words, they are synchronized. The same principle applies to the case cited. When the dog trots over a bridge which is otherwise empty it imparts a series of shocks to the bridge which are exactly timed. The succession of the shocks, each in itself extremely small, sets up a series of vibrations in the bridge which are naturally accumulative. If you were to deal with the matter theoretically and assume an infinitely long bridge, the vibrations set up by the trot of the dog would, at some point, reach a magnitude which would wreck the bridge. Practically, of course, no such results are possible. We have personally seen very decided vibrations set up in a bridge by a dog trotting over it. We also know of instances when ten or twelve cadets on a schoolship have caused the ship to roll alarmingly by running from one side to the other of the deck at a certain cadence. When a body of soldiers marches across a bridge the order of "route step" is always given to prevent the creation of vibrations which would certainly be dangerous.

(14126) O. B. asks: 1. A claims that the current carrying capacity of an electric conductor is proportional to its surface area as the current flows only on its surface. B claims it is proportional to the volume of conductor. Which is right? 2. Which is the better conductor, solid or flexible wire? A. 1. The carrying capacity of an electric conductor for a direct current is proportional to its area of cross section. A direct current of electricity flowing in a conductor flows through the body of the conductor, and penetrates all parts of it. A discharge of a high potential character is a sudden rush of current lasting for an instant only, and this does not penetrate the body of the conductor. An alternating current of high frequency acts in the same manner. With a frequency of 1,000 or more the current is mainly on the surface of the wire. In the oscillatory discharge of a Leyden jar with a frequency of several millions, the conducting skin is probably less than a hundredth of a millimeter thick. A hollow tube or a flat metal tape conducts this discharge better than a solid round wire. For this reason some advise that a tube or a flat strip of metal be used for a lightning conductor. 2. For the direct current it is a matter of convenience whether a stranded or solid conductor is used, if the area of cross section of metal is the same in both. For an alternating current a stranded conductor is better, since there is less body of metal within the conductor.

(14127) A. A. D. asks: 1. What is the cause of lateral "drift" of long range projectiles? 2. Is it caused by the gyrostatic action due to the "spin" of the projectile? 3. Is air friction one of the causes? A. The "drift" of a projectile is caused by the gyroscopic action generated by the rotation of the projectile. The unbalanced air pressures around the projectile cause it to "precess." This precession (a wavering of the axis of the shell which causes the path of the nose to form a spiral around the trajectory) keeps the axis of the shell closely tangent to the trajectory because of the unbalanced air resistance below the nose, causing the shell to hit the target nose-on. The frictional resistance of the air on the two horizontal sides of the shell is unbalanced by the speed of rotation. The shell, of course, is constantly falling, and the friction of the air on the sides is then equal to the speed of the fall minus the speed of rotation on the left, and the speed of the fall plus the speed of the rotation on the right, because all of our guns are "right-bore"—that is, the twist of the rifling is to the right. Consequently there is always more resistance on the right side of the nose than on the left, just as there is more resistance below the nose than above. Then the gyroscopic force which draws the nose of the projectile into the resistance below the point, causing it to always fall point first, also draws the nose to the right into the resistance on the right side of the point causing "right drift."

(14128) C. E. asks: 1. I notice that during cold weather while sitting or stirring about in my office, I seem to become charged with positive (?) electricity to such a degree that I am mildly—certainly unpleasantly—shocked whenever I grasp the telephone metal or water spigot—any metal circuit connected with the ground. I do not think strangely of this except that my friends laugh at the idea and say it is impossible, ascribing the story to the imagination. I know it is not peculiar to me, for I have known it to be commented on by a friend remote from here regarding himself—and I presume it is common enough. I attribute the charge in my case to sitting in leather chairs, the constant friction generating a kind of positive electricity anxious to get to earth. I, also, have a warm moist skin (hands, for instance) which might facilitate the "charge." I do not notice this during warm weather. Kindly arm me with scientific defense against my unbelieving friends. 2. Please, also, give me the explanation of this: I notice (and others have since called attention to it) that during a moving picture "show," just ahead of the picture, say, when the advertisements are being exhibited—that the different colors thrown on the screen (representing the various letters) seem to have a different plane or surface upon which they rest, some colors being nearer to the observer, and others further back on the stage. I am aware of the different "fields of vision" for the different colors, but am unable to associate this in any way with the phenomena described. A. 1. Becoming charged with static electricity by friction in cold weather is a very common experience, and is no illusion of fancy. We have had the same inquiry from several persons this winter. It may even be that this season has been better adapted for this experiment than the average. The charge is induced by friction, sometimes of the dry soles of the shoes on a woolen carpet, or it might be from hitching about in a leather-bottomed chair, and then moving to the telephone or other metal article, which is grounded. 2. We have noticed the fact that some colors seem to stand out more from a screen or wall in the dark than others do. But we have no scientific explanation for it.

(14129) W. G. L. asks: If four No. 10 wires of copper, aluminum, brass and iron, about 5 or 6 inches long, are held with one end in a Bunsen burner flame, bits of wax placed on the other ends will melt off the wires in the order in which I have named them above. Sometimes the wax melts from the aluminum before it does from the copper, and in every case they are so close together that there is but a very slight difference as compared with the time required to melt the wax on the other metals. Can you explain to me why aluminum should come so close to copper in such a test? I have worked out the values of the thermal conductivity divided by the specific heat times density as follows:

$$\frac{\text{Conductivity}}{\text{Sp. Ht. x Der.}}$$

Cu — 89
Al — 60
Brass — 32
Fe — 17

It seems to me that these numbers ought to give a good idea of the relative rate of rise in temperature at the end of the wires, and the reciprocal ought to approximate the relative times required for melting the wax. Yet this is not verified by experiment, for the aluminum often melts its wax before the copper. A. The "diffusivities" of the metals which you give differ from the values given in the Smithsonian Physical Tables in some instances. The values given in the Smithsonian Tables are: Copper, 1.133; Aluminum, .826; Yellow Brass, .339; Wrought Iron, .173. These values do not explain the result of your experiment, nor can we give any explanation why your sample of aluminum should have so nearly the value of copper.

(14130) J. B. C. writes: Please allow me, most respectfully, to suggest that you reconsider your answer to question 14031. It is associated with good names, but is not correct. It would be correct if the horizon were a fixed plane and the sun journeyed westward to his setting. For the purposes of this question we may set aside refraction and observation, both diurnal and annual. We may consider the sun a *fixed* point in space. He is sending out rectilinear rays of light in all directions continuously. When an observer's horizon plane turns to such a position that one of these lines of light lies in that plane, the sun is *then*, if he still exists, *exactly in that plane*. A similar statement holds for a meridian plane or for the optical axis of a telescope. Neptune does not transit four hours before we record it. Stars do not transit and set *in years* before we so record them. If such were the case all our conceptions of the related positions of celestial objects would be a hopeless jumble of confusion. Apply the corrections for refraction and observation, then when a star transits in a meridian circle, it is *at that instant* on the meridian, provided it still exists where it was eight minutes or eight hundred years before when the light that affects the eye left the star. The lines of light continuously exist; it is a mere incident that some plane is so placed that one of those lines lies in it. A. The case is that of light sent out from a body which is at rest with reference to the earth which receives the light. The sun is the only body of this sort. Its light occupies 8 minutes and 19 seconds in coming to the earth. In that time the earth travels about 9280 miles at the rate of 18.5 miles per second. Thus the light which we receive at any moment left the sun when we were 9280 miles away from the place where it strikes the eye. This does not affect the apparent place of the sun. We were in error in our statement that it did in the query referred to by our correspondent. This is like the throwing or batting of a ball. A fielder runs to get in line with the ball and catches it. He sees the person who threw or batted the ball in the place from which he threw it. So we see the sun in its real place.

(14131) W. G. W. asks: Through your most valuable paper kindly answer the following questions: 1. Does electricity weigh anything, if so, what is the apparatus used? 2. Is it classed as a solid, liquid, or gas? A. Electricity is not thought to be ordinary matter, and it does not have weight as one of its properties, in the same sense as does iron or lead on the earth's surface. There are those who believe that electricity, negative electricity, is the tiny electrons of which the atoms of bodies are composed, or else that these electrons always carry charges of negative electricity. Thus you see that electricity cannot be classed as a solid, a liquid or a gas.

is plain: Capacity for really comfortable and leisurely slowness is a missing attribute of pleasure cars, yet to be supplied though not yet strongly demanded. And likewise the whole department of deliberate slowness for certain kinds of utility vehicles is neglected, though the demand is evident.

Two difficulties have had much to do with the small degree of success which has attended the few and sporadic efforts made for producing slow and low-powered vehicles of relatively high load capacity. One is that such vehicles have never been so constructed that they *could not* run fast when going downhill, and low-priced construction—indispensable in this class of work—will not endure the strains of "letting her go." The other difficulty depends only upon a peculiar oversight in engineering, found represented in every slow motor vehicle and tractor that has come to my notice: In the gears employed for changing the speed of the motor into a slow pull at the wheels—with practically no momentum in the vehicle to reduce the stresses—there is never provided enough wearing surface, and the lubricant is squeezed out between gear teeth and from bearings, causing very rapid wear of the cheap material and much drag on the scant power.

In motor ploughs the power used for turning the soil is far too directly identified with that used for propulsion. The idea of working the soil at nearly right angles with the direction of the machine as a whole has not even been tried, although such a system would permit the two tractor wheels of a pair to run on the same level and would ease the propulsion problem on difficult ground by gearing the hard work down to the lighter. But this is a subject too broad and complicated for more than a vague hint in this place.

Speed Regulations

Laudable efforts are made to have the speed regulations for automobiles made uniform in different states and cities, with variations for specific cause only, but it is hard to imagine that any speed regulations depending for enforcement on intense watchfulness by the police are to be permanently required. A straitjacket is not clothes for a normal citizen. As safe traffic is the object, it is proper to inquire if cars by their construction are as safe as they should be to make restrictive regulations superfluous. If they proclaimed their speed and direction plainly to every onlooker, the basis for a public opinion would be created, and public opinion would eventually compel moderation and care. This factor is now lost in the vagueness of all estimates of what a car and its driver are really doing. In 90 cases out of 100, more or less, the reckless "get by" without blame. On the other hand, many perfectly well-meaning persons fall victims to the regulations. If there is in the car itself something that is at fault and in need of a remedy, it will explain why coercion and restriction of persons, be they drivers or owners, work no better for safe traffic than they do. There is indeed a fault in the cars, and it has been pointed out several times in public, but its importance has never impressed people in general, because it is related to physiological laws which few understand or care about—though nobody would deny that a blind person requires assistance or that an invisible car would be dangerous in the streets. As the lives of children are especially involved, let me outline the facts:

The movements of cars, as they are, do not challenge attention until they are directly and consciously observed. Safety in traffic depends upon all persons concerned hearing and seeing what is going on in time to make them act accordingly. Where noises are numerous and conflicting it is the "corner of the eye" which is the guardian of safety. The blurred vision entering the eye from the side is the only vision that gives warning before it is too late. Clear focus spans only about 15 degrees. It comes after the

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warning has turned the eyes or head to see better. And it is the physiological law that a threatening movement in one's surroundings, if it is not heard (or scented) reaches consciousness without fail only if marked changes occur in the contours of the visual image of it. A play of colors or light, increasingly vivid as distance shortens, is second in importance for rousing attention. But of all moving things in the traffic, excepting street railway cars, automobiles present the smallest contour-changes to indicate speed and direction. And the tram cars have their tracks for a danger signal.

Authorities in physiology (knowing all about the function of motion in physical sensations) will pick up this clue—which is here sketched in crudest brevity—sooner or later. They will write about it. Physicians will thereafter begin to think of what it means. Lawyers will learn about it. An accident will come up in court and will be explained scientifically as due mainly to the absence of contour-changes and the resulting lack of attention on the part of the child. And eventually it will occur to a sufficient number of influential persons that "these funny contour-changes in moving cars which theoretical experts are prating so much about" may be produced by design. The idea will then reach the legislatures, where it will be killed for want of inducements, being neither popular nor remunerative. Meanwhile, the children, who have not learned to make themselves miserable in the streets by a constantly strained attention, can go on falling victims to cars because they do not notice them in time.

Billiken-on-the-Radiator has come and gone. Were his place to be taken by a colorful mechanical panache making a few sounds and movements easily associated with speed and direction, a good beginning would be made; perhaps all that is necessary. But such a panache will not be capably designed till the principal of contour-movements is recognized and the demand created. At this point there is an achievement awaiting more than merely mechanical consummation.

Past generations did something in this line when they cleared the course for swift and silent sleighs by pluming the horse and belling the terrets.

Design of Motor Stages

Omnibuses, jitney buses, motor stages, livery cars and taxicabs are ripe to receive far more attention from designers than has been their share in the past. They represent the people; motordom without ownership. They must pay for themselves without any circumlocution, in cash revenues. Buses and cabs should be worked at least 18 hours per day, preferably 23 in the cities. A vogue for touring in America by organized motor stage relays is a possibility which has not yet been extensively considered. New design in this class of automobiles, which must be convertibly closed or open—promptly, as the weather happens—is bound to come, since it is needed. It should not be surprising if the great desire for lighter construction were to result in the complete discarding of the usual frame in these vehicles and in working out their necessarily high bodies on the plan of the trussed bridge span, easily supporting their own weight between the axles, as well as the power plant and the passengers. A plan of this nature would make room for a large number of solutions before the best for each kind of vehicle were evolved. It is certain that in all of these vehicles, except the taxicab, the frame is now supporting too much material that rides but does not work or pay fare.

If picturesque and commodious motor stages take nice people over pleasant, dustless roads to other nice people and places, for pleasure or for business and work, and this is to be a regular feature of American life, in addition to the whole traffic in privately owned cars, there are evidently several more very large sub-

jects in which all might be interested who are interested in automobile construction.

Road Carpets

In the broad national life to which the perfected automobile leads, good hotels and good roads will be indispensable. And advancement in popular education and sociability should therefore not be far behind among the motorist's hobbies. The road is almost a physical part of the automobile. Its construction is much more of a problem than that of the car. Whatever may be said of hotels and popular education, with regard to roads it is certain that they must be made different from what they are. Dust will not continue to be tolerated. Brittle-surfaced roads are doomed. Undrained roads are a waste of labor. But we cannot cement and waterproof cut-stone to the depth of 10 inches on every byway. Not enough cement or tar is produced or can be spared. Other methods must be evolved. Probably the surface of highways, like the rails of railways, must eventually be produced in mills or factories, but mills working with local products for local roads. The hempen waterproofed road carpet over a merely dry and drained earthen foundation seems not so far off. There is in this respect a dream of a new social structure and new graces in country life—a dream which young engineers may take up and turn into a mature plan for large and interesting work closely allied to that of the motor vehicle industry.

Industrial Preparedness for Peace

(Concluded from page 8)

These conditions could not obtain unless we were dependent upon foreign bottoms.

Return Cargoes Basis for Permanent Shipping and Commerce

Permanent commercial relations must be based upon conditions permitting full cargoes to be shipped on both voyages. There are great deposits of iron ore in Brazil. Bolivia has large quantities of tin ore. We are having serious difficulty in getting tin from the usual European sources. We import about 45,000 tons of tin annually. New smelting enterprises in this country are designed to have a capacity that could take care of a large part of the Bolivian output. Argentina furnishes us with large quantities of quebracho and quebracho logs and meats. Chile has practically the greatest deposits of nitrate in the world. The United States and Alaska have coal resources equal to those, it is estimated, of all the rest of the world combined. Both in variety and quality it compares with any other coal in the world, and may be mined from one half to one third of the cost that English coal is mined at. The method of handling coal and loading vessels in the United States is admitted to be the most efficient known. These factors of cheap, high-grade coal, efficient transportation facilities, and coal-handling equipment afford a great opportunity for the development of markets for American coal in the South American markets. In these facts lie the basis for a permanent and great shipping trade between the United States and the ports of South America in bulk cargoes that are available from both ends. The shipping yards of the United States are working to their utmost capacity, and according to the best available figures, for the first three months of this year the American shipping yards launched a tonnage equal to that launched by the British yards.

These facts, together with the probable enactment of the shipping bill by Congress, give reason for the belief that permanent shipping routes with stable rates and regular sailings will be available for the foreign trade.

Never has there been a more golden time for American enterprise, energy and good judgment.

Conditions Upon Resumption of Peace

The future cannot be forecast. It is reasonable to believe, however, that the processes of restoration will be rapid. Cities, bridges, highways, railroads will have to be rebuilt and rehabilitated.

Labor will speedily translate itself into value and into securities. These processes will require our aid and our contribution.

What the permanent conditions thereafter will be depends largely upon the terms of peace and the ideas that shall then become dominant in national policies. It has been suggested that international interdependence in world commerce, which has obtained heretofore, will be superseded by conditions of intensive nationalism for the purpose of national self-sufficiency. Whether this be true or no, our great local markets, natural resources and fortunate situation will assure us of most favored positions in the evolution of world commerce.

What we may look forward to with certainty is that the future will require a greater degree of intelligent coördination of our strength as a nation than we have ever heretofore attained. The problem of Democracy is to become equally efficient with autocracy. We shall be obliged to conserve the resources so lavishly given to us. With our raw land taken up we shall be required to develop intensively rather than extensively. The competitive system which we have ordained in Democracy to be the basis of our industrial life must be made stable, sane and helpful and not destructive and demoralizing. Wastes in production, in distribution and manufacture must be prevented so that wages may be made constant and living conditions stable and the well-being of society conserved. Industrial conditions must be stabilized, intensified and withal made competitively equitable and sane; so that efficiency and science shall be in accord with that freedom in industry which Democracy demands.

Government Contributions to Commercial and Industrial Preparedness

Government agencies now existing are effectively supplementing these conditions which afford present opportunities. The Federal Reserve system, now recognized as one of the greatest contributions to our financial history preserved the financial equilibrium during August of 1914, a period of the greatest stress in history, has released credit to industry and has reduced possibilities of panic to a minimum. The Federal Trade Commission is seeking to establish a basis for a sane and constructive competitive condition in industry. It has addressed itself to two of the great problems affecting the business of the country immediately arising out of the European war. For the protection of American industry it has urged upon Congress the prevention of dumping and unfair competition by foreign manufacturers. For the promotion of foreign trade it has recommended to Congress legislation to encourage coöperation of American manufacturers and exporters to project foreign enterprises and to meet the competition of foreign cartels and combinations. The Department of Commerce is daily expending the service of a corps of highly trained commercial attachés to advise the industrial and commercial enterprises of this country of opportunities abroad. Within a short time there will have been created a non-partisan tariff commission charged with the duty of preserving our tariff relations upon a basis which changed conditions in international commerce shall require.

These contributions are an earnest of the attitude and desire of the Government vigilantly and effectively to protect and promote American industry and opportunity under the changed conditions of the times.

At this critical juncture in our history Government is seeking in every manner to aid, sustain and develop American commerce and industry, to protect it in every fair way with reference to international competitors; to use every resource at its command which shall keep the nation prepared in commerce and industry to the same degree that it seeks to preserve peace with honor and to protect the nation from hostile or military aggression from without.

A Window that is Different from Other Windows

(*Concluded from page* 18)

dow question from a practical standpoint for more than twenty-five years.

The new window is made of solid steel, the sections being selected to give maximum strength and lasting wear, and the corners consisting of mortised and tenoned riveted joints. It is divided vertically in two equal sections, which are joined by a brass hinge extending the full height of the window. Each section is supported in the center, at top and bottom, by arms of forged steel, which swing on a common center at the top and bottom of a stationary upright, set in the center of the frame. Both sash operate simultaneously under the symmetrical control of the arms, coming together when opened. A slight push or pull is sufficient to open or close the window, not much greater effort being required for a large window than for the smaller type. The operation is distinctly positive in that it does not rack the frame or sash, and there is no contact of metal, thus eliminating any wear due to friction; nor are there any pulleys, chains, weights, or gearing of any kind to take up valuable space and require constant repairs. The window operates noiselessly, and the glass can be cleaned on both the outer and inner surfaces from the interior, in a simple and easy manner, saving labor and insurance and eliminating the great danger incident to the cleaning of windows from the exterior.

Requiring no window boxes to hold pulleys and other auxiliaries, the sections of the window take up very little space. This allows a maximum glass area for the admission of light. When it is fully open maximum ventilation can be secured; and it can be opened so as to give perfect ventilation at top and bottom without draught. To establish its value for protective purposes, this window has been subjected to some interesting tests, the results of which have been unusually good. Under heavy air pressure it was found impossible to force flour through the window, establishing its dust-proof qualities. To prove its value under severe weather conditions, a window was placed in the thirty-fifth story of the Woolworth Tower, New York, for a period which covered all seasons of the year, and it was found to be proof against the elements. Under high pressure equal to that of the wind blowing at the rate of 140 miles an hour, the window allowed very slight leakage. The fire test was conducted by the Underwriters Laboratories in Chicago, and after the application of intense heat followed by cold water, the window was found capable of operation, which is most unusual.

Enlarging Pictures Without a Lens

(*Concluded from page* 14)

The circumstances which led to the conception of the new process are somewhat odd. We give the story in the inventor's own words. He tells the facts as follows:

"One morning as I was stropping my razor I observed a peculiar effect. On the hollow-ground back of the razor is an inscription "OUR BEST MAKE." As the blade moved over the strop I noticed a peculiar distortion of the characters, which appeared something like this: "*OUR BEST MAKE.*" I wondered what could be the explanation of this. Persistence of vision could not account for it, for that would merely cause a blurring of the letters. Then I reflected that, owing to the cylindrical curvature of the hollow-ground blade, there was reflected back to the eye at any moment only a narrow band of light (my back being turned to the window). Furthermore, as the razor moved along, a different portion of it from instant to instant appeared brightly illuminated. As the inscription on the razor was in motion in a line oblique to its long axis, successive portions of it were revealed to the eye in different positions, with the result of causing the inscription to appear, owing to persistence of vision, as one whole, but

with its several portions rearranged in accordance with the character of the motion. Then I began to wonder how I could prove the correctness of my explanation. In pondering over the experimental means that might be employed to demonstrate this I was finally led to the process and apparatus protected by my United States Patent 1,176,384."

For the readers of the SCIENTIFIC AMERICAN a touch of personal interest is added to the new process by the fact that its inventor, Dr. A. J. Lotka, was for a number of years Associate Editor of the SCIENTIFIC AMERICAN and Editor of the SCIENTIFIC AMERICAN SUPPLEMENT.

Our Blind Army

(*Concluded from page* 11)

situation would still be a precarious one; and according to authority, at least 50 aviators and 150 aeroplanes should be at General Funston's disposal—not in the near future, but now!

Fortunately for us, the Mexican military organization has no aerial equipment to speak of; as far as is known, only a few machines of nondescript varieties are in the country at present, and most of them probably useless for immediate military service. It is true that some ingenious Mexicans might undertake the construction of aircraft, but then they would eventually fail in their purpose through lack of proper engines with which to equip their product. So it is that in the event of war American aeroplanes will be required for scouting purposes only.

But what if we should be obliged to fight with a leading power? It would then be no longer a question of scouting in comparative security: we would have to engage in aerial battles with enemy airmen, both in carrying out reconnaissance flights and in preventing the enemy from carrying out his; we would have to brave the fire of enemy anti-aircraft artillery of the most efficient type; we would have to defend our cities and military works against air raids undertaken with both aeroplanes and dirigibles.

An authority on European aeronautical matters who is now visiting this country has stated that the United States is at least two years behind time in the technique of military aviation. This opinion is entirely plausible; the daily *communiques* of the fighting nations are proof enough: we read of aerial fleets of over 50 machines flying in a quasi-naval formation—slow, weight-carrying bombardment-planes flanked by swift, machine-gun armed fighting-planes and armored cannon-planes—into the enemy country for perhaps one or two hundred miles in order to bombard a town or military establishment; of remarkable combats in the air, with the aviators riddling each other's machine with machine-gun fire; of aerial range spotters correcting by radio the fire of batteries on distant targets; of thrilling bomb attacks on Zeppelins by aeroplanes. Yet our Army is not familiar with these details of modern military art; we have only regarded the aeroplane as a means of reconnaissance in place of cavalry patrols and scouts.

There are in the United States a fair number of aircraft factories, at least one of which has an average capacity of 10 to 12 machines per day, with the others capable of a somewhat more modest output. Obviously, the American aeronautical manufacturer is not at fault in our aerial unpreparedness; even at the present moment he is supplying machines to the fighting powers—machines that are proving the equal and in some instances the superior of those of European manufacture. The fault is entirely with a Government that has failed to recognize the importance of an adequate air fleet, just as Great Britain long disregarded the aeroplane as a military necessity until her authorities became alarmed at the magnitude of Continental air fleets and the sinister maneuvers of aviators abroad. Great Britain had to develop a home airship industry; ours already exists. With the necessary appropriations for an adequate air fleet, the machines could be rapidly secured, even in times of emer-

gency. But the personnel of such a fleet is not a matter of a few days' or weeks' training; it is a matter of months.

England and France have each more than 3,000 aviators in active service, and Germany is probably not far behind. The United States has scarcely more than 100 trained pilots, military and civilian. At the present time the Army has not a single permanent aviation school, no steps having as yet been taken to acquire North Island, at San Diego, where the Army aviation school has been temporarily located. So, under existing conditions, allowing that the necessary funds are available for the materiél, what of the necessary personnel? The answer is this: If the machines are to be provided, schools must be immediately established for the training of the men—the veritable backbone of the service.

The Aero Club of America believes that it would take $5,000,000 to establish ten aviation schools where 300 Army and National Guard officers and civilians could be trained so as promptly to get 100 aviators for the Mexican campaign; it would take $773,550 to organize, equip, and maintain each of the five aero squadrons needed for the Mexican expedition, and funds ought to be allowed to supply aeroplanes for the National Guard of the different States, so that they could form aero companies. Steps should be taken immediately to begin constructing dirigibles and observation balloons, and for these an additional $2,000,000 should be allowed. In fact, for the conditions encountered in Mexico it is more than likely that dirigibles would prove superior, in many ways, to heavier-than-air craft. Kite balloons for observation purposes, such as dot the fighting fronts of Europe, are absolutely indispensable if we are to use our fighting forces in the most efficacious manner. Aeroplanes alone cannot perform the functions of kite balloons, and barely those of dirigibles. The recent appropriation for aeronautics in the Army appropriation bill, although increased by amendment from $1,222,100 to $3,222,100, is entirely inadequate to the immediate needs of our soldiers, not to mention their peril if they were to face the forces of one of the leading powers in the near future.

Turning from the inglorious to the sublime, indications are not lacking that all this is soon to be changed. There are persistent rumors that the necessary funds will shortly be placed in the hands of the Army authorities for the foundation of a real aerial fleet, complete in equipment and personnel. Perhaps the necessary appropriation may be voted before this issue reaches the reader, for the Government is now fully cognizant of the seriousness of our aerial unpreparedness. The lessons of the European war have not been lost: awakened from its lethargy, the Government now realizes that far more aeronautical equipment is necessary and that in actual warfare the destruction of both men and equipment runs high, hence the need of a much larger force than is absolutely required, in order to allow for the wastage.

A valuable experience and knowledge belong to every American aviator who is now flying for France, for the little group of our intrepid airmen has met with all the conditions of modern air service. They have engaged the Germans in numerous aerial combats; they have undertaken reconnaissance flights over zones dotted with anti-aircraft guns; they have probably done artillery spotting. The decorations bestowed upon them by the French authorities are proof of their success in these undertakings. When the opportunity arrives, it is for the United States Army to make good use of the experience and knowledge of these airmen, in the training of other aviators in the science and art of modern warfare. That these men should have gone to France for personal motives is a happy event indeed for our young aeronautical branch. Perhaps, after all, this country will not be two years behind time if this source of information and invaluable training is used to the fullest extent. And when the

requisite number of aviators are trained and ready for service, even if they number as high as 2,000, to supply the mounts will be a matter of rapid production in which the Americans excel.

NEW BOOKS, ETC.

THE ELEMENTS OF PHYSIOLOGY AND SANITATION. By Louis J. Rettger, Ph.D. New York: The A. S. Barnes Company, 1916. 12mo.; 397 pp.; illustrated.

This brief elementary text introduces the pupil to such knowledge as is necessary to the maintenance and promotion of both individual and public health; its physiology places the emphasis not upon arbitrary rules but upon the facts from which the rules proceed. Training in first-hand observations is secured by simple experiments. The course offered is so elastic and flexible that the less experienced teacher with comparatively poor equipment may by a process of selection and omission adapt the teaching to his own requirements and limitations, yet as a whole it will be found well suited to the expert with his superior equipment. The problems of health and disease are clearly stated, and foods, bodily functioning and mental hygiene are intelligently and appealingly discussed.

GENERAL SCIENCE. First Course. By Lewis Elhuff, A.M. New York: D. C. Heath & Co. 1916. 12mo.; 441 pp.; illustrated.

The arrangement under which these fundamental facts of general science are presented is the result of long experiment on the part of the author. The value of health is first impressed upon the young student, and protective measures are suggested: logical thinking is skilfully encouraged, so that accuracy in judgment may early be developed; the text avails itself so largely of the common experiences of pupils that it creates in the most natural manner a desire for further satisfaction and by this means scientific investigation is made a habit. The illustrations are well-chosen from all branches of natural science. The work is stimulating in its material and suggestions for class study, and throughout all its apparent diversity recurs the basic ideas of matter and its properties, of the reaction of matter upon matter, and of energy as a property of matter.

MEMORABILIA MATHEMATICA. Or The Philomath's Quotation-Book. By Robert Edouard Moritz, Ph.D., Ph.N.D. New York: The Macmillan Company, 1914. 8vo.; 417 pp. Price, $3.

The loving labor of a decade has gone into the collection and arrangement of these quotations and devotees of the "queen-mother of all the sciences" will heartily appreciate a work so informative and inspiring. Sources, and preferably accessible sources, are in every case given, and the quotations are admirably arranged according to theme; the first chapter, for example, includes only those which define mathematics and indicate its scope and objectives; other chapters deal with the teaching of this science, with study and research, with persons and anecdotes, with the fundamental concepts of time and space, and with paradoxes and curiosities. Such great teachers as Newton, Descartes and Poincaré of course appear time and again throughout the pages, but whenever any lesser light has given to the world an apt and illuminating thought, Dr. Moritz has been quick to recognize its value and give it a place. Notwithstanding the fact that the arrangement of the text assures fairly easy reference, there is an exhaustive index. Teachers, writers, and students, whether their particular study be mathematics or something else, will find the compilation invaluable, for all sciences into which the elements of order and measure enter are closely related to mathematics, and much of the philosophy of life itself pervades the volume.

AIRCRAFT IN WARFARE. The Dawn of the Fourth Arm. By F. W. Lanchester, M.Inst.C.E., M.Inst.A.E. New York: D. Appleton & Company, 1916. 8vo.; 240 pp.; illustrated. Price, $4 net.

The great influence which the aeroplane has developed during this war, notably by almost eliminating the surprise attack on land and by furnishing most superior scouting facilities to the battleship at sea, has forced a recognition of this arm of warfare which the past had been slow to accord to it. One theory evolved by Mr. Lanchester, and carefully expounded in the present work, is regarded by Maj. Gen. Sir David Henderson as a valuable contribution to the art of war; this is the "N-square law" relating to the concentration of force, and having a direct bearing on command of the air. The author was one of the first men to point out that this command of the air would probably become as important nationally as the command of the sea. He has studied dynamic flight in its military applications for many years, and has kept closely in touch both with problems and practice. His comprehensive survey includes the strategic and tactical uses of the aeroplane; its employment in combatant service; the importance of the rapid-fire gun; and armor in its relation to armament. He inclines to the belief that British machines are in many ways superior to those of friend and foe, at least in flying capacity if not in fighting ability; and that they possess greater speed and climbing power, have attained an inherent stability, can stand harder usage, and can better resist the weather. Since the book is composed of a series of articles for the most part written shortly after the outbreak of the war, it must not be taken as presenting the actual conditions prevailing today, but it is well worth the study of all those who are interested in aircraft as a "fourth arm" of great promise and many possibilities.

PRINCIPLES OF STRATIGRAPHY. By Amadeus W. Grabau, S.M., S.D. New York: A. G. Seiler and Company, 1913. 8vo.; 1217 pp.; illustrated. Price, $7.50.

To the English-speaking geologist, whether student or professional, this comprehensive volume discloses much that would otherwise have to be sought among foreign literatures. The section on marine bionomy was published in 1899, and other portions of the work have appeared separately down to 1913, but the author performs a valuable service to geology in bringing this correlated material together in one volume, and in adding to it sufficiently to round out our interpretation of the history of the earth by an intelligent reading of the records graven in its rocks. Regarding the earth as a central mass surrounded by various envelopes of known composition, the different sections of the work treat these envelopes under the names of the atmosphere, the hydrosphere, the lithosphere, and the pyrosphere or zone of volcanic activities; there must be added to these the biosphere, or zone of organic life, which more or less permeates the first three envelopes. This classification indicates the broad scope of the summary. The final chapter deals with palaeogeography, and since the really important literature of this branch has only come into being within the last decade, the author's summary is valuable and timely. The work should open up farther horizons to many a student, enabling him to view these rich fields from a new culmen.

WENZEL'S DIAGRAM PAPER. For Use On The Typewriter. New York: John Wenzel, 1916. Single sheets, each 15 cents; one dozen sheets, $1.

With this new and attractive paper graphic charts may be quickly and neatly executed upon the typewriter, with the exception of the curve line. The paper, 8½ by 10½ inches, fits the standard machine, and generous margins are provided so that the complete data may be filled in. There are no confusing vertical lines; instead, dotted lines at the top and bottom of the chart readily determine the position of any required vertical line; the green ink employed in the printing admits of the making of photo-engravings direct from the original diagram; duplicate copies are readily taken by means of carbon paper. By using the logarithmic paper, we obtain the correct relationship between large and small quantities, and on the same sheet, a result impossible with the co-ordinate paper in common use.

RAMBLES WITH THE SWITCHER. An Opening in the Game of Checkers. By William Timothy Call. New York: W. T. Call, 1916. 16mo.; 76 pp.; illustrated. Price, 50 cents.

Mr. Call knows how to teach without becoming tedious; his booklets are always worth reading. In this midget volume he deals, in his unconventional and breezy way, with the Switcher opening in checkers; this was the invention of James Wyllie, the "Herd Laddie," and is a weak and apparently silly opening that has "switched" and perplexed many good players.

ELEMENTS OF MINERALOGY. By Frank Rutley. Revised by H. H. Read, A.R.C.S., B.Sc., F.G.S. New York: D. Van Nostrand Co., 1916. 8vo.; 416 pp.; illustrated. Price, $1.25 net.

The popularity of Rutley's "Mineralogy" is evidenced by the fact that this is a nineteenth edition. While the old arrangement has been largely retained, there are numerous concessions to the modern viewpoint, and the work is intended for the experienced prospector no less than for the young student; the commercial value of ores is regarded by the reviser as injecting an added element of romance into the study. The work sets forth the physical, chemical, and optical properties of minerals, describes metallic and non-metallic species, and carries a glossary and a table of the geological systems.

ORGANIC AGRICULTURAL CHEMISTRY. (The Chemistry of Plants and Animals.) By Joseph Scudder Chamberlain, Ph.D. New York: The Macmillan Company, 1916. 8vo.; 336 pp.; illustrated. Price, $1.50.

This text-book provides a course that considers biochemistry in its relation to agriculture, and one that may profitably be pursued by students having no special knowledge of systematic organic chemistry. The systematic exposition is followed by a physiological section, in which, contrary to usual custom, animal nutrition is given precedence over that of plants. The final section takes up crops, foods, and feeding, and presents the chemical basis for the valuation of animal foods without concerning itself with the details of practical operation and results. Years of experience in the teaching of students in the Massachusetts Agricultural College has gone to the making of the book, and a companion volume is announced, which will deal with the chemistry of soils and fertilizers.

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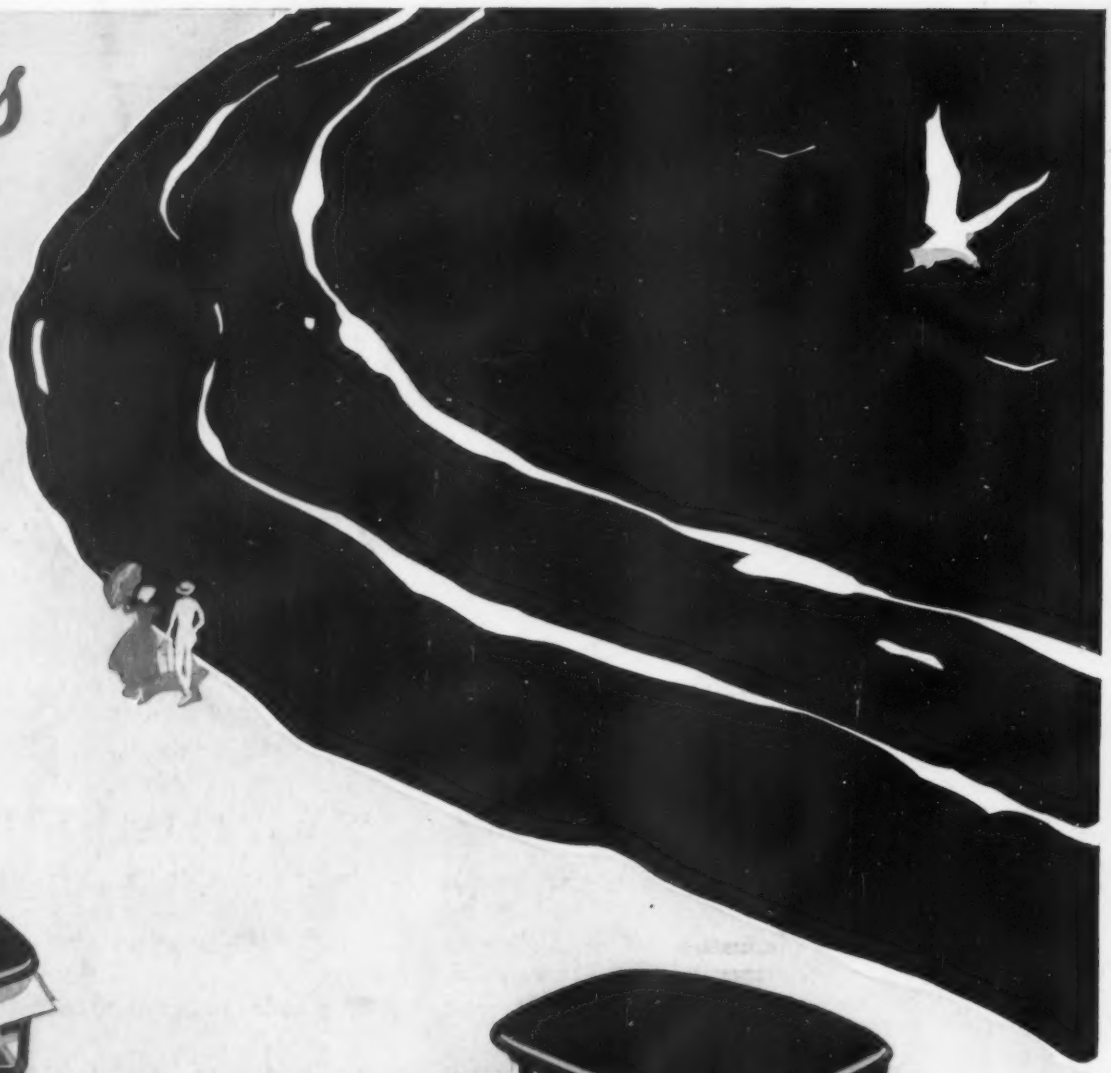

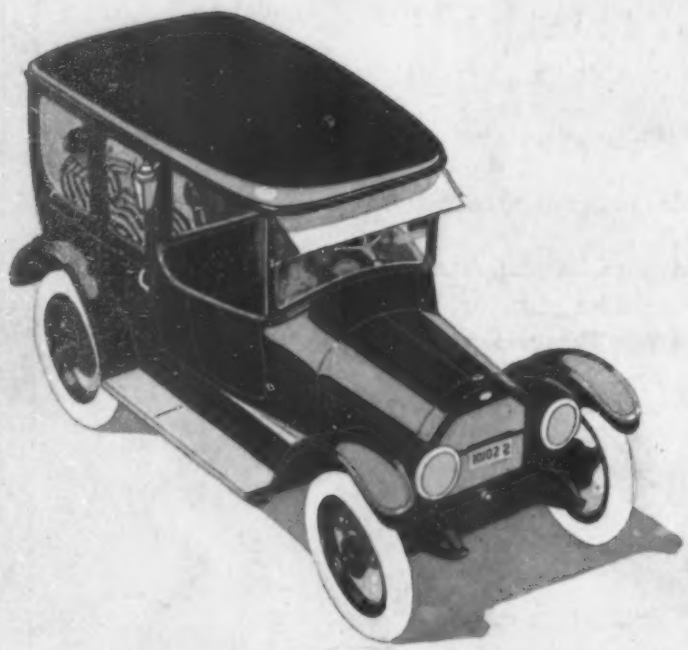

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